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INTEGRATED AUTODIN SYSTEM ARCHITECTURE REPORT. PART 1.(U)

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INTEGRATED AUTODIN SYSTEM ARCHITECTURE REPORT

IASA

Prepared by: DCA/CODE 534 DECEMBER 1977

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Inter-Service/Agency AMPE (I-S/A AMPE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report (Part 1) identifies near term Automatic Digital Network (AUTODIN) implementation alternatives and recommendations to meet user needs for common-user record and data communications. It provides the framework for the evolutionary development of an Integrated AUTODIN System (IAS) on a terminal-to-terminal basis including architectural design considerations for post-1983 time frame.

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USERS GUIDE TO THE INTEGRATED AUTODIN SYSTEMS ARCHITECTURE (IAS) REPORT, PART 1

1. General. This is the first in a series of three Integrated AUTODIN Systems Architecture (IASA) Reports, addressing the 1978-1983 (near-term) implementation alternatives for the Integrated AUTODIN System.

2. Applicability. The user is cautioned in the use of this report. Most of this report has been updated by the IASA Report, Part 2, dated March 1979. Nearly all the milestones, schedules, and deployment figures have been changed in the Part 2 Report. The Part 1 Report addresses the near-term in greater detail than the Part 2 Report, and is useful to the user as background information.

3. Approval. The IASA Report, Part 1, dated December 1977 was approved by the Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (ASD/C^3I) in October 1978. Together with this approval, the DCA was directed to: (1) identify, develop and promulgate necessary standards; (2) identify the roles and relationships of components of the Integrated AUTODIN System; (3) establish an Inter-Service/Agency AMPE Program; and (4) complete the development of functional specifications for the common family of terminals.

4. Definition Changes. Reference to the Local/Regional Access Node (LRAN) and the Centralized Service Facility (CSF) should be deleted. The I-S/A AMPE provides the functional capabilities projected for these concepts.

5. Architecture. The nodal functions of the existing AUTODIN Switching Centers (ASCs) have been combined with AMPE functions to provide a network access element now designated the Inter-Service/Agency AMPE (I-S/A AMPE). The AUTODIN I ASCs will be phased out by "phasing in" three or more I-S/A AMPEs on a regional basis to service the AUTODIN I subscribers then connected to the ASC. The IAS Architecture provides for a Common Family of Network Elements (CNFE) which includes the I-S/A AMPE, the DoD AUTODIN Subscriber Terminal (DAST) Family, and the DoD Standard Network Front End (SNFE), AUTODIN Switches, among other IAS element configurations.

6. Availability of Report. This report has been placed in the Defense Technical Information Center (DTIC) and may be ordered under AD- . The DTIC, formerly the Defense Documentation Center (DDC), is located at Cameron Station, Alexandria, VA 20315.

7. Point of Contact. For further information on the applicability and content of the IASA reports, the point of contact is Mr. C.I. Eisiminger, Network Access Systems Branch, DCA Code 262, 8th & So. Courthouse Rd., Washington, D.C. 20305. Phone (202) 692-5127/5129. AUTOVON 222-5127/5129.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report identifies near-term, 1978-1983, Automatic Digital Network (AUTODIN) implementation alternatives and recommendations to meet user needs for common-user record and data communications. It provides the framework for the evolutionary development of an Integrated AUTODIN System (IAS) on a terminal-to-terminal basis to include architectural design considerations for post 1983.

The purpose of the Integrated AUTODIN System Architecure (IASA) is to guide the evolution of telecommunications systems toward a more efficient means of message processing and data communications while offering standard solutions to user requirements.

On 5 February 1975, OSD/DTACCS (now ASD/C^3I) tasked the Defense Communications Agency (DCA) in coordination with the Services/Agencies, to develop an IASA on a terminal-to-terminal basis and based on the architecture to define a common family of AUTODIN terminal hardware and software. On 12 December 1975, OSD/DTACCS approved the DCA IASA development plan. As a result of this plan, DCA is responsible for accomplishing three objectives: (1) develop a system architecture on a terminal-to-terminal basis; (2) develop terminal specifications; and (3) develop related standards, formats, and procedures.

The overall objective of the IASA project is to design and engineer a DoD-wide common-user system for communicating narrative and data traffic, for the period 1978 to 1990, based upon AUTODIN I and AUTODIN II, which is complete and integrated from end to end. The 1978-1983 implementation alternatives include determining the number and location of AUTODIN I Switching Centers (ASCs), AUTODIN II Packet Switching Nodes (PSNs), AMPEs, and user terminals. The 1984 to 1990 time frame will see the implementation of new hardware/software elements to replace obsolete equipments. The planning of a smooth transition over the 1978-1990 time frame is one of the important aspects of the IAS architectural strategy and is developed throughout this report. In addition to major network elements, this report covers such topics as user requirements, data communications trends, standards, security, integration of the WWMCCS Intercomputer Network (WIN) into AUTODIN II, and the IAS transition strategy. Figure 10, page 94, provides the IAS transition strategy for the period 1978 to 1990.

The following time periods have been assigned to the various parts of the IASA project:

1. Near term: 1978-1983.

a. Deployment of AUTODIN II packet switches in CONUS and to a limited extent overseas.

b. Thinning of AUTODIN I switch population.

c. Complete deployment of the current generation of AMPEs in 1982 with further access area needs provided by an Inter-Service/Agency AMPE, which can serve all DoD users in an area and interface either AUTODIN I or AUTODIN II switches.

d. Deployment of a common family of AUTODIN terminals based upon functional specifications.

2. Mid term: 1984-1988.

a. Further deployment of AUTODIN II switches overseas.

b. Phase-out of AUTODIN I switches.

c. Provision for AUTODIN I unique functions in either an augmented Inter-Service/Agency AMPE or a Centralized Service Facility associated with AUTODIN II nodes or both.

3. Far term: 1989-Future. A third generation data system to be defined in conjunction with the other third generation subsystems of the DCS.

This report (Part 1) provides AUTODIN implementation alternatives through 1983 and preliminary architectural information for the post-1983 period. Section V provides conclusions and recommendations to this IASA project report. In January 1979, Part 2, architectural alternatives for the period 1984 to 1990 will be provided. In August 1979, Part 3, functional specifications for a common family of AUTODIN terminals will be provided.

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SECTION I

SECTION I

INTRODUCTION

A. Purpose. This report identifies near term, 1978-1983, Automatic Digital Network (AUTODIN) implementation alternatives and recommendations to meet user needs for common-user record and data communications. It provides the framework for the evolutionary development of an Integrated AUTODIN System (IAS) on a terminal-to-terminal basis to include architectural design considerations for post 1983.

The purpose of the IAS Architecture is not to create a new system to be superimposed on all other user systems in a duplicative way, nor is it to exploit technological advances in the data processing industry when there is no well defined need to do so. The purpose of the IASA is to guide the evolution of telecommunications systems towards a more secure, accurate, survivable, and efficient means of message processing and data communications while offering standard solutions to user requirements.

B. Background. In July 1974, the General Accounting Office (GAO) published a report that was critical of the Department of Defense (DoD) for (1) not having a single agency responsible for management of the entire AUTODIN system to include AUTODIN terminals; (2) for a poor telecommunications center consolidation record; and (3) for duplication of effort and proliferation of LDMX-type AUTODIN terminals by the Military Departments (MILDEPs) and DoD Agencies. The GAO recommended to OSD/DTACCS (now ASD/CCCI) that a single AUTODIN manager be appointed to resolve the problems as they surfaced.

On 5 February 1975, OSD/DTACCS acted on the GAO recommendation by tasking the Defense Communications Agency (DCA) in coordination with Services/Agencies, to develop an Integrated AUTODIN System Architecture (IASA) on a terminal-to-terminal basis and based on that architecture to define a common family of AUTODIN terminal hardware and software.

On 12 December 1975, OSD/DTACCS approved the DCA IASA development plan which would address the backbone, concentrators, and terminals as a single integrated system with processing functions allocated to system components on the basis of how and where they can best be performed. As a result of this plan, DCA is responsible for accomplishing three objectives: (1) develop a system architecture on a terminal-to-terminal basis; (2) develop terminal specifications; and (3) develop related standards, formats, and procedures.

As an outgrowth of the OSD tasking, JCS Memorandum of Policy 165, titled: AUTODIN and Associated Message Processing Systems, was issued on 5 May 1976. MOP 165 establishes AUTODIN as the DoD common-user data communications system, directs maximum use of the system elements, identifies criteria for interservice telecommunications center consolidation and automation, provides safeguards to prevent proliferation of non-standard terminal systems, and provides policy and guidance for use of new equipments using automation techniques through the AUTODIN.

C. Organization. The IASA Project organization is shown in Figure 1. Control of the project is exercised through the AUTODIN Systems Integration Branch (Code 534), Headquarters DCA. Technical Support is provided by the Defense Communications Engineering Center (DCEC). Representatives of DCA, MILDEPs, National Security Agency (NSA), Defense Intelligence Agency (DIA), and Defense Logistics Agency (DLA) are formed into a Technical/Policy Panel which serves as the forum for discussion of IASA issues. In addition, there are four working groups, each chaired by DCA, with participation from MILDEPs and DoD Agencies.

The IASA Project working groups were established to develop the required design baseline inputs. The Security Working Group objective is to insure that user security requirements are factored into the IASA. The User Needs and Capabilities Working Group objective is to develop a data base containing user functional requirements and capabilities and to perform a detailed analysis of the various Automated Message Processing Exchanges (AMPEs).

The Standards and Procedures Working Group objective is to develop policy, procedures, and standards for message preparation, input, transmission, output, and distribution facilities. The Target Environment Working Group objective is to provide a description of technical, economic, and organizational factors that influence the IASA development. The results of these working group efforts are presented in this report.

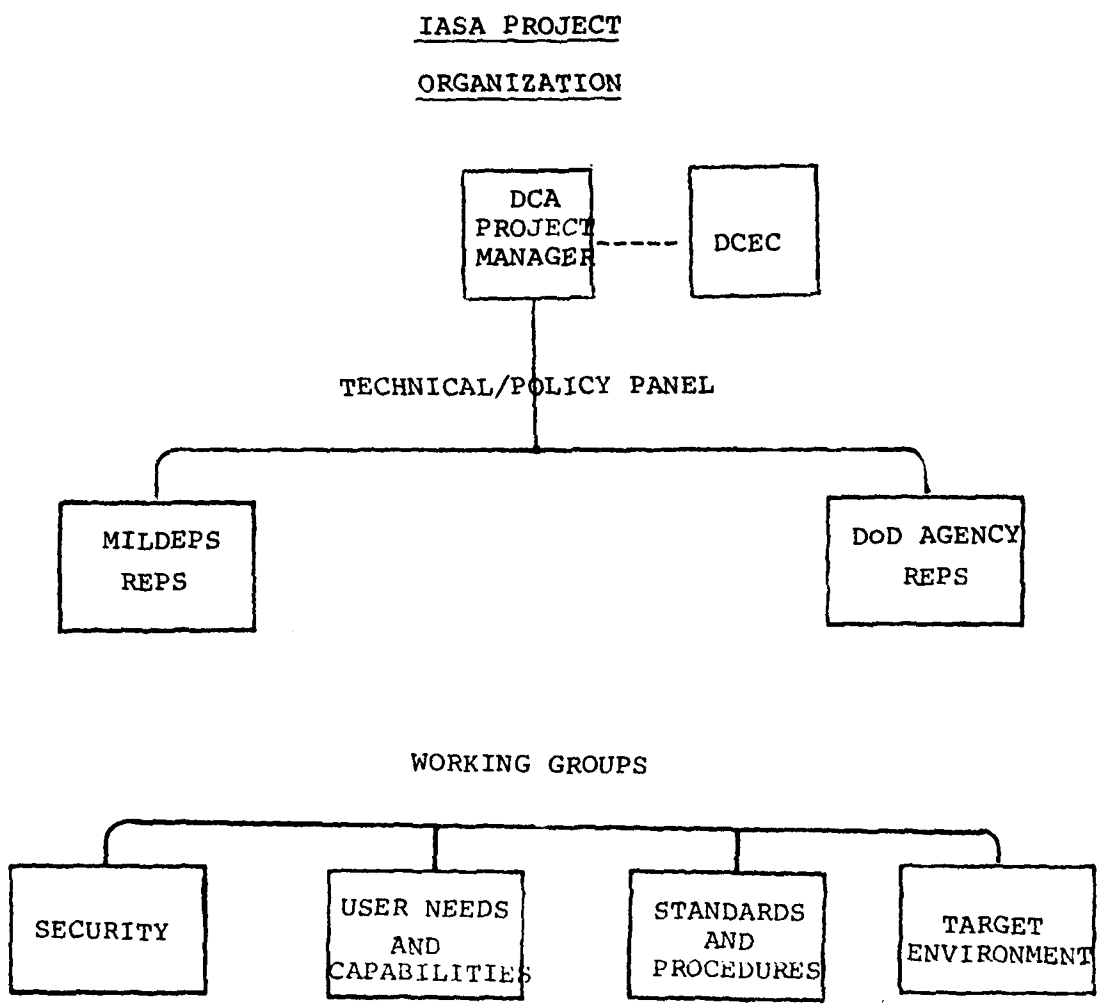


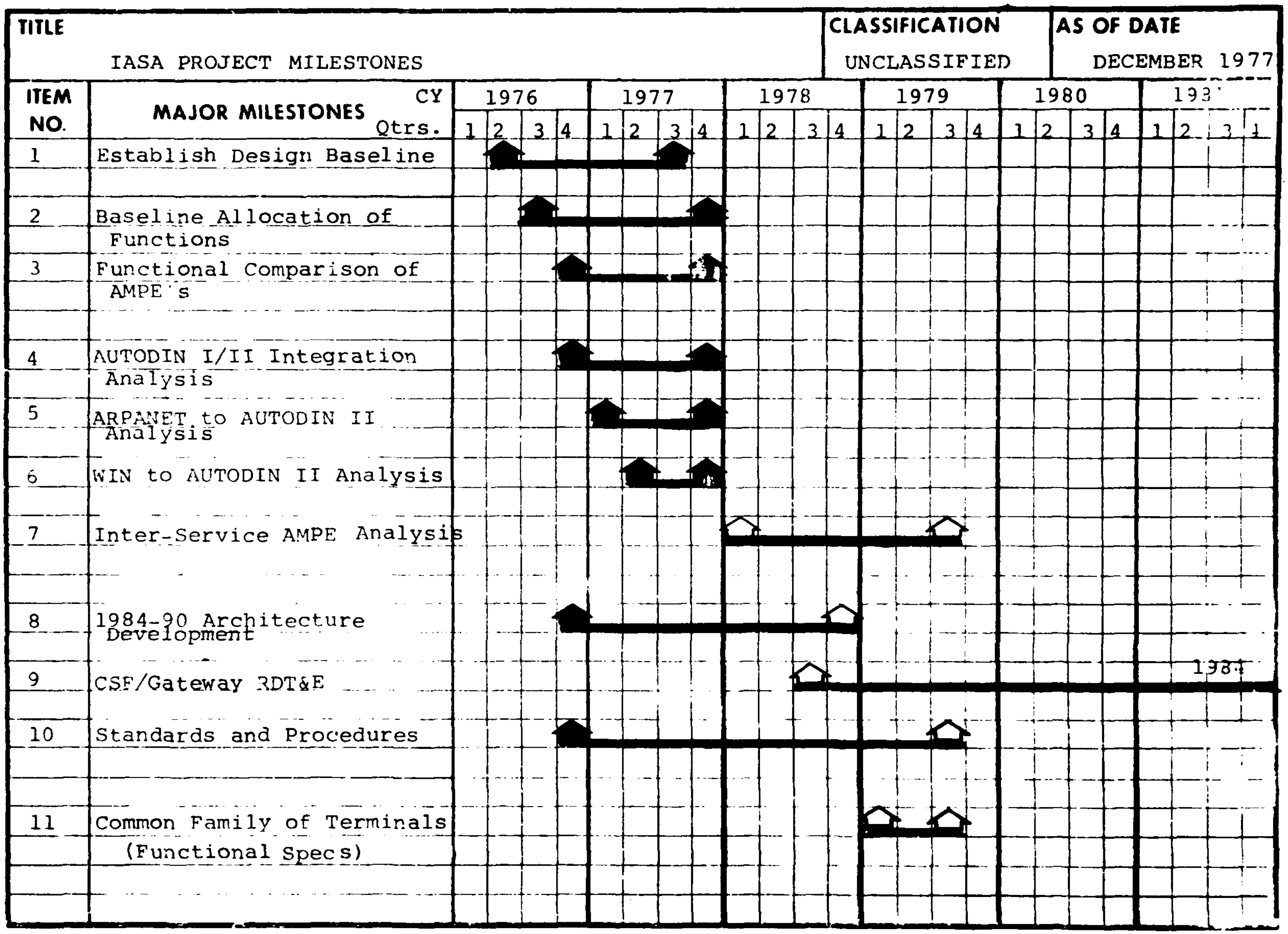
Figure 1

D. Scope of Effort. The overall objective of the IASA project is to design and engineer a DoD-wide common-user system for communicating narrative and data traffic, for the period 1978 to 1990, based upon AUTODIN I and AUTODIN II, which is complete and integrated from end to end. The IASA design is by necessity evolutionary in development, with the key ingredient being responsiveness to user needs.

The 1978-1983 implementation alternatives include determining the number and location of AUTODIN I Switching Centers (ASCs), AUTODIN II Packet Switching Nodes (PSNs), AMPEs, and user terminals. The near-term IAS concerns itself with what is presently or soon to be implemented. The 1984 to 1990 time frame, on the other hand, will see the implementation of new hardware/software elements to replace obsolete equipments. The architecture for these new elements must be developed during the near-term IAS in order to be available during the post-1983 period.

The planning of a smooth transition over the 1978-1990 time frame is one of the important aspects of the IAS architectural strategy and is further developed throughout this report. In addition to the major network elements previously stated, this report covers such topics as user requirements, data communications trends, standards, baseline allocation of functions, security, and integration of the WWMCCS Intercomputer Network (WIN) into AUTODIN II.

Reference is made to Figure 2 for IASA project milestones, which logically divides the IASA project into three parts. This report (Part 1) provides AUTODIN implementation alternatives through 1983. In January 1979, architectural alternatives (Part 2) for the period 1984 to 1990 will be provided. In August 1979, functional specifications (Part 3) for a common family of AUTODIN terminals will be provided. Reference is made to Appendix 1 for list of acronyms.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1 Establish Design Baseline
2 Baseline Allocation of Functions
3 Functional Comparison of AMPE's
4 AUTODIN I/II Integration Analysis
5 ARPANET to AUTODIN II Analysis
6 WIN to AUTODIN II Analysis
7 Inter-Service AMPE Analysis
8 1984-90 Architecture Development
9 CSF/Gateway RDT&E
10 Standards and Procedures
11 Common Family of Terminals (Functional Specs)

Figure 2

SECTION II

SECTION II

REQUIREMENTS

A. General. This section identifies user requirements as they are expected to exist in the early 1980's. In addition to their importance in determining near-term AUTODIN implementation strategies, these requirements will be used as guidelines in architectural development of the IAS for the 1984 to 1990 time frame.

The extent to which the IAS will provide increased user satisfaction over the AUTODIN system of today is a function of several factors. For instance, the AUTODIN II system and the AMPEs are being fielded primarily because AUTODIN I does not effectively meet user requirements. In addition, the advancing state-of-the art in technology offers considerable promise of increased capability at reduced costs. To aid in understanding these technological changes, an assessment of the data communications environment of the 1980's will be provided in this section. In general terms, increased user satisfaction will result from:

- Improved writer-to-reader speed-of-service.
- Improved telecommunications center operations.
- Improved system responsiveness to crisis management.
- Improved system responsiveness to data users.
- Increased transparency of information processed throughout the network.

In conjunction with these IASA objectives, standards are discussed with additional information provided in Section III. D.

B. Evolving Data Communications Environment. Viewed in the perspective of the IAS 1983 time frame, no one can predict with confidence what the data communications environment will be in the mid 80's. The AUTODIN system

design is complicated because we cannot start from a zero baseline, but must be able to merge, integrate, replace subsystems, stretch out the old when it is more cost-effective, and add new capabilities in an evolutionary manner.

1. Information Systems. In addition to the traditional areas of command and control, intelligence gathering, logistics, and personnel management, emerging information systems are finding application in a wide variety of situations requiring the rapid assimilation and/or processing of information affecting many other aspects of defense management. As technology changes, so do the concepts by which we understand the content of information and the need for its transfer from one point to another. For many systems, computer and terminal facilities are being located at widely dispersed geographic points, and therefore large volumes of information must be transferred between these facilities. In addition, a need is rapidly emerging in response to the evolving complexities of our operations to exchange information between traditionally isolated systems on a more or less routine basis.

a. Within the DoD community, two related developments could have considerable impact on the near-term IAS:

(1) The advantages of consolidating ADP and telecommunications functions is gaining wider recognition within the DoD management structure.

(2) The economies which can be achieved through automation in the various areas of traditional management functions are giving new impetus to the development of complex management information processing systems.

The ADP and telecommunications fields have developed independently; each has maintained its own separate identity, discipline, doctrine, and terminology. The current need, however, for the acquisition and sharing of highly dispersed, nonhomogenous, time-sensitive data has resulted in a growing concern on the part of both fields of interest for the need to develop an information systems approach to solving the common problems arising from internetting. There is a growing awareness of the need to merge ideas and practices in order to create viable integrated information systems rather than continue with the maintenance of two separate fields.

b. While there is a trend toward consolidating "teleprocessing" functions, the vastly greater accumulations of information made possible by the available technology is creating a current demand for a more sophisticated communications network than that presently available within the current message switching environment. This sophistication of communications demand arises from several factors:

(1) ADP systems are no longer being implemented in isolation of one another but are being consolidated and interconnected within a complex arrangement.

(2) Rapid response times normally associated with priority matters affecting the national security are now required on a regular basis for matters affecting management efficiency. In particular, the philosophy of the new management information systems is to record information into computer format for electrical transmission at the information source, thereby avoiding duplication in effort and time lags inherent in the more conventional acquisition of information.

(3) The extent of the problems related to the new information handling systems is resulting in a substantial increase in the requirement for bulk data transfer with associated handling efficiencies which cannot be achieved within the existing switched networks.

(4) With the increasing complexity of DoD management decisions, as well as those of government and the business community as a whole, the need for collecting vast quantities of data to support complex resource management allocations and decisions is becoming more and more essential to orderly government operation. Accordingly, there will be a considerable increase in the volume as well as type of traffic handled by the data communications networks of the future.

2. <u>Trends</u>. The following are some of the forecasted trends for the 1980's:

a. The requirement to move more information in a shorter time span will be reflected in greatly enhanced efforts to automate source data entry at the communications terminal with direct voice/data input offering the greatest system improvement.

b. To reduce access line costs, the primary interface between the user and the long-haul communications network, at least for major military installations, will be a large base concentrator(s). These concentrators will provide a significant improvement over those currently available in providing true "user-to-user" multi-media communications service.

c. The separate functional areas of telecommunications, data automation, and resource management will be merged into one area treating information creation, processing, and resource management transfer as an integrated whole.

d. Developments in large scale integrated circuits and plasma display technologies offer considerable potential for new teleprocessing applications.

e. Routine clerical functions such as file updating, text correcting, dictation, etc., will be performed on a routine basis by the teleprocessing system - often from the central file.

f. The fact that personnel costs constitute the bulk of the annual increment of life cycle costs for administrative type services will be the major driving force for conversion to ADP operation.

g. Multiple copies of manuals and other bulky documentation will be reduced to a single control file with electrical access and peripheral reproduction capability. The transfer of the large volumes of data associated with this concept will be facilitated by the increased bandwidth available for bulk data transfer and the application of "slow scan" techniques together with "cheap" terminal storage.

h. In order to increase both employee and management productivity, more and more personnel will have communications terminals at their desks.

i. With the increasing deterioration of mail service as volume grows and transportation and handling costs increase, facsimile "mail" will likely become a much more attractive alternative to current operations and will place a substantial demand on the IAS.

j. With the availability of larger bandwidths, facsimile may be coupled directly to the office copiers and operated at compatible speeds.

k. The use of the Touchtone telephone as a cheap computer terminal with voice answerback or a coupled digital display, will greatly expand teleprocessing applications.

l. Optical processors will greatly enhance pattern recognition, associative processing, and other areas in which a very large number of different data elements must be correlated.

m. World patterns will change as screen-to-screen communications (teleconferencing) proves to be an attractive alternative to business travel.

n. Extremely large computer files (data banks) will be available in which every item stored can be retrieved in a fraction of a second. Banks of data on many subjects will grow to the extent that computers will be used as "librarians: for aiding in the worldwide search for particular items of information.

o. Computers will drop in costs at a faster rate than communications lines. To some extent, this trend will counter the trend towards increased use of data transmission (i.e., greater decentralization).

C. Functional Requirements. In order to meet user requirements of the 1980's, the IASA must improve speed and quality of telecommunication service while decreasing costs. The following paragraphs identify functional requirements which the IASA must satisfy:

1. Improvement of Writer-to-Reader Speed of Service and Reduction in Telecommunications Manpower. An important objective of the IASA is to develop a system which provides improved writer-to-reader speed of service and improved quality of service with the same manpower or less. This objective suggests a requirement for automation at those points in the system where delays occur because of queues for human intervention, and where manpower intensive tasks are performed. Writer to reader speed of service is subject to delays outside the realm and control of telecommunications. Therefore, the inter-relationship between administration and telecommunications should be addressed.

a. Plain Language Entry. In order to exploit Optical Character Reader Equipment (OCRE), narrative users must be provided the capability to enter a message into AUTODIN, either directly or through a telecommunications center, using a plain language address. This capability now exists only through manual, semi-automated, or automated conversion of the plain language address to a routing indicator (PLA-RI) at the telecommunications center. The IASA must provide automation of this conversion process somewhere in the system or obviate the need for conversion by using the plain language address or other writer-provided data as the routing means throughout the system.

b. Internal Routing Determination and Preparation for Distribution. This function, now performed by the user after delivery of the message, must be automated within the system if the system is to be responsive to writer-to-reader requirements. Decision logic tables are now used in AMPEs to make internal routing determination and subsystems are now available which prepare messages for distribution. This function must be standardized and assigned to a specific element of the architecture. Moreover, standards must be established which will permit automated internal distribution determination to be optimized.

2. Improvement of Telecommunications Center Operations. As various telecommunications center functions are automated to reduce manpower requirements and to improve speed of service, telecommunications center operations will be improved through simplification. Tape cutting and PLA-RI conversion will be virtually eliminated and the function of the internal routers will be significantly reduced. However, other requirements which tend to complicate operations will persist. Among these are file and retrieval, message reproduction and distribution and the maintenance of traffic statistics.

a. File and Retrieval. These functions are now performed in various ways depending upon the predominant traffic media, the equipment available and the customer demand for retrieval. In some cases, only header information is filed and retrieval is accomplished by request to the ASC. In telecommunications centers with a magnetic tape capability narrative messages are usually filed in their entirety and retrieval is performed locally. At some telecommunications centers a user requirement exists to retrieve all referenced messages prior to delivery of an incoming message; hardcopy

filing is normal in these cases. Where necessary, the IASA effort should provide standardization through the use of nodal facilities to serve manual telecommunications centers, and local filing where the capability exists. The requirement for reference retrieval should be questioned and, if valid, the referencing of messages should be standardized and formatted to facilitate automated retrieval.

b. Message Reproduction and Distribution. Message reproduction is now a manual operation at most telecommunications centers. Three methods of reproduction are predominent: the use of reproducible mats, the use of manifold forms in reception and xerograph methods. Of these, only xerography lends itself to automation. Navy has acquired a system which xerographically reproduces incoming messages and distributes to allocated bins. A system of this nature should be considered in the IASA as a standard method of improving the performance of the reproduction and distribution function.

c. Maintenance of Traffic Statistics. This function includes data required for traffic management such as queue status, system availability, and terminal status. The performance of this function currently is dependent upon the availability of processing power at the telecommunications center. Those centers equipped with AMPEs have fully automated statistics maintenance; those with smaller processors have partially automated statistics. Mode V teletype terminals and Digital Subscriber Terminal Equipments (DSTE) generally depend upon manual statistics gathering. The need in this area is to standardize the types of statistics gathered, to automate statistic gathering locally if possible and to provide automated statistics gathering from AUTODIN service centers or AMPEs for manual telecommunications centers.

3. Improve System Response to Crisis Management. AUTODIN response to crisis situations is a function of system survivability and reliability. Survivability of the current system is enhanced through multiple homing and contingency alternate routing. Reliability of the AUTODIN backbone is maintained at a high state through management by exception with very stringent intervention points. Reliability of the system terminals and access lines is generally less than that of the backbone and is not subject to the same management techniques.

a. Dual Homing and Contingency Alternate Routing. Terminals served by the system must have the capability to be made as survivable as necessary. This requirement is now met by multiple homing and contingency altrouting. As a minimum, the capability for multiple homing of terminals must be retained to overcome the inherent vulnerability of a single access line. Contingency altrouting must be provided within the system either from an ASC or at the AMPE for connected remotes or at both locations. Diverse routing of transmission media must be provided to insure the additional flexibility needed to make the IAS more survivable.

b. System Reliability. The reliability of the AUTODIN backbone, based upon the factors of availability and accuracy, is adequate for all foreseeable requirements. The terminals, on the other hand, have not demonstrated comparable availability and are more susceptible to inaccuracy because of line strikes. The IASA must consider improvement in error detection and correction.

c. A design goal of the IASA should be the evolution of a system which is, as a minimum, as reliable as the current backbone. As AUTODIN II is deployed and the IAS evolves toward a terminal to terminal system, stringent management thresholds should be maintained and extended to all system elements. The ultimate goal should be a 99.5% availability intervention point applicable not only to the backbone, but also to the access lines and terminals. This goal must necessarily be subjected to continual critical review to ensure the state-of-the-art will permit attaining and maintaining such an ideal at a reasonable cost.

4. Improve System Responsiveness to Data Users. AUTODIN II should provide the data user with a backbone system responsive to his needs for interactive communications. In some cases, however, the data processing installation (DPI) and the telecommunications center serving it have developed a relationship in which some functions of the DPI are shared by the telecommunications processor. In these cases, AUTODIN II may not be able to supplant the existing AUTODIN I terminal. Development of a common user solution should encourage such users to reestablish DPI independence.

a. Scheduled Delivery of Incoming Data Traffic. Since most DPIs schedule CPU time on a 24 hour basis, provisions must be made for delayed or scheduled delivery of incoming data messages. Store and forward telecommunications systems can accommodate this service at any point where bulk storage capacity exists. A packet switching network cannot store data in this manner; if the requirement for scheduled delivery persists, provisions for intransit storage must be considered in the IASA.

b. Preprocessing of Magnetic Tape Traffic. In conjunction with scheduling and/or delaying delivery of data traffic, a requirement exists to sort incoming magnetic tape traffic to permit immediate delivery of high precedence messages. Sorts by content indicator code are also required in some cases to permit the delivery of tapes or messages (i.e., logistics, administrative, etc.) at different times. In a packet switching network without the assistance of a store and forward facility, this type of service cannot be provided except at the data source. The validity of the requirement as well as the means to meet it must be considered in the IASA.

5. Transparency of Information Processed Throughout the IAS. The system must not be tied exclusively to a specific character set or formats. The user must be able to introduce any data into the system with only a minimal amount of identification and accounting information. The specific form of the entered data must be unrestricted and available to the user at the system destination in a form identical to its originated form. Interaction between the system and the data should not be discernible by the user.

6. Standardization. The IASA design goal of a terminal to terminal system will require broad range standardization if all economies are to be realized. Standardization of telecommunications procedures such as precedence handling, message forms, addressing and routing and staffing is essential to interservice operability; once procedures are standardized, further standardization and subsequent savings will be possible in the several areas discussed below. A word of caution is, however, in order. Although standardization offers considerable promise in the reduction of costs and in increased interoperability, it is not a panacea. In fact, standardization must be carefully controlled to ensure flexibility is maintained as a design objective. The IASA must possess sufficient flexibility to meet changing user

requirements, and to incorporate new technology and techniques afforded by the continually advancing state-of-the-art. The two goals of flexibility and standardization are not, however, incompatible. For example, such mechanics as functional specifications, rather than specifications incorporating specific implementations, can provide the requisite degree of standardization without sacrificing flexibility.

a. Software Techniques. Software cannot be completely standardized until all users have common hardware, a condition which may be neither possible nor desirable. A high level, machine independent, telecommunications oriented computer language could, however, provide some standardization in cases where assembly language is not required to meet the necessary throughput. The most fertile area for standardization is in software techniques. After standardization of procedures is accomplished, there is little barrier to developing a common telecommunications software language.

b. Software Development/Maintenance Facilities. Army, Navy, and Air Force all operate major software development/maintenance facilities. After standardization of procedures and software techniques, the consolidation of these software facilities is a logical consideration and should be explored in conjunction with IASA development.

c. Telecommunications Equipment/Services Procurement. Although successful centralized procurements have occurred, procurements of this type often fail to meet the specialized needs of the Services/Agencies. If standardization of procedures and software can be achieved, specialized needs should be reduced to a minor consideration enhancing the probability that central procurement can be employed for the majority of requirements.

d. Crypto Devices. Economies can be realized by establishing a single family of crypto devices for use throughout the IAS. These savings would evolve primarily in the areas of procurement and maintenance.

e. The modes of operation identified as AUTODIN I Standards have become accepted industry-wide and have become universal descriptors of telecommunications protocols. Of the five modes, only three (Mode I, Mode II and Mode V) are in common use today. Also, AUTODIN II has introduced a new set of modes which are not related to AUTODIN I modes. As the IASA is developed, a comprehensive set of AUTODIN modes, including Mode I, Mode II, Mode V, and the AUTODIN II modes should be developed, clarified, and promulgated as IAS standards.

7. Telecommunications Functions Expected to Increase in Demand. Many telecommunications capabilities exists within the current state-of-the-art which are not now fully exploited, either because the requirement has not been identified, or because current DoD systems cannot economically perform them. The Integrated AUTODIN System should incorporate within itself the capability to exploit these capabilities to meet expected new or increased requirements.

a. Teleconferencing - A service which provides a video or data conferencing mode. The purpose of the service is to take the place of an in-person meeting or conference. Data conferencing service is less of a departure from current services and the video mode is a considerable change and could have enormous impact on both system design, cost, savings, energy consumption, and the manner in which business is conducted. Data conferencing could be conducted on a keyboard CRT display, whereby members of the conference address one another. Conference traffic can be held at a switch node while a conference participant is away from his terminal. Video conferencing is envisioned through use of multiple cameras which are aimed and activated by voice recognition.

b. Word Processing - A service composed of features and functions which aid in the preparation of typed material. The service interfaces with a secretary or typist via a low speed terminal, generally a CRT, keyboard device. The computer aids in composition by providing multiple editing capabilities, reformatting, and file storage. In this manner, corrections are easily made and copies obtained. The communications aspect involves the coordination of the document between parties remote from each other and the final distribution of the document. This will speed the delivery of the document and aid in the transportation of classified material.

c. Internetting of Data Bases and Networks - The requirement and the capability to interconnect networks and to access large remote data bases will be present in the near-term IAS.

d. Facsimile - This has been demonstrated for use in AUTODIN I. AUTODIN II will offer a more effective common-user system for the facsimile user.

D. System Requirements.

1. AUTODIN I. Statistics over the last two years reflect growth rates in AUTODIN I of approximately 3.4% for messages and 11% for lineblocks. The difference in growth rates is

due in large part to subscribers processing bulk data (magnetic tapes, cards). Over the period 1975-1977 the number and distribution of AUTODIN I terminations are as follows:

	1975	1977
CONUS	840	856
Pacific	232	205
Europe	253	261
TOTAL	1325	1322

With the projected growth in AUTODIN I traffic volume, the trend to higher speed access lines will be watched closely to measure the impact on ASC throughput. A further analysis of the terminal environment is provided in Section III.D.

2. AUTODIN II. The following statistics represent the demand for AUTODIN II service projected out to 1983:

- 42 ADP Systems
- 156 hosts, 1262 terminals
- Busy hour traffic of 19.13 x 10^9 bits (exclusive of AUTODIN I traffic)

In addition to the above projections, overseas requirements for AUTODIN II have been identified for Europe, Pacific, Alaska, and the Canal Zone. The method of terminating these overseas requirements will be multiplexing to a CONUS PSN.

a. The European area requirements for AUTODIN II are for 26 terminations with in-service dates between January 1979 and December 1981. Of these, 19 are located in the Federal Republic of Germany, three are in England, two are in Spain, and one each in Italy and Saudi Arabia. Line speeds for these requirements range from 150 to 19.6 kilobaud. An alternative approach is presented in Section III.B., whereby a PSN would be located in Pirmasens, Germany in 1981.

b. The Pacific area requirements for AUTODIN II are for 16 terminations with in-service dates between January 1979 and December 1981. Of these, twelve are located in Hawaii with one each located at Clark, Philippine Islands, Kamiseya, Japan, Guam, Mariana Isands, and Seoul, Korea. Line speeds for these requirements range from 150 to 19.6 kilobaud. An alternative approach is presented in Section III.B., whereby a PSN would be located at Wahiawa, Hawaii in 1981.

c. The Alaska requirements for AUTODIN II are for twelve terminations with in-service dates between January 1979 and December 1981. All are located in the Elmendorf/Anchorage area. Line speeds for these requirements range from 300 to 9600 baud.

d. There is one Canal Zone WWMCCS Intercomputer Network (WIN) termination at a line speed of 9.6 kilobaud.

SECTION III

SECTION III

SYSTEM ARCHITECTURE (1978-1983)

A. Definition. The IAS Architecture is a system-level description which considers all the user motivated functions (e.g., plain language addressing) and system-motivated functions (e.g., routing) required for end-to-end data communications and teleprocessing services, allocates these functions to a feasible subset of the set of all possible elements (e.g., nodes, multiplexers, terminals, etc), partitions the elements into levels (i.e., backbone, local and regional access area), specifies the transmission media and connectivity policy for interconnecting the various elements and network levels, and describes the method of system operation. In doing so, hardware and software features will be included, and the way in which the elements are interconnected into a network topological structure will be specified. All protocols, interfaces, routing methods, and other operational and control procedures which determine how the interconnection and operation of elements provide the required service to the user will be stipulated.

The IAS Architecture will be comprehensive enough to allow the development of requisite functional specifications and to allow for meaningful costing at the system level. For those elements which already exist or are already designed, engineering and software documentation or specifications and planning documents will be incorporated into the architectural description. For new elements, functional specifications must be developed to complete the description.

The IAS Architecture will establish the necessary elements for the orderly growth of DoD data communications, and provide decision makers with the requisite criteria, in terms of planning and costing data, to make accurate, timely and meaningful decisions. Decisions predicated on the IAS Architecture will be founded upon a total terminal-to-terminal system design, eliminating functional duplication and enabling a cost-effective approach to the acquisition of needed communications capability. The approved IAS Architecture will be the basis from which the detail design can begin.

Designers will use the IAS Architecture as technical and policy guidance to prepare development plans for obtaining the hardware and software needed to advance from the 1978-1983 architecture to the mature architecture of the future.

The purpose of this section is to provide near-term implementation alternatives and recommendations for major network elements to include backbone switches, access area exchanges and terminals. Figure 3 illustrates the near-term architecture which consists of the Backbone and Access Area (Regional and Local).

B. Backbone Switches.

1. AUTODIN I. The Automatic Digital Network (AUTODIN) I is a store and forward switched network of the Defense Communications System (DCS) which functions as a single integrated worldwide, high-speed, computer-controlled, general-purpose communications network, providing secure record communications service to the Department of Defense (DoD) and other Federal agencies. Figure 4 shows a worldwide layout of the 17 AUTODIN Switching Centers. AUTODIN I has been operational for approximately 15 years and has undergone numerous enhancements and expansions to meet the growing requirements for data/record communications. In addition, there are many enhancements and improvements in process and/or planned for the AUTODIN I to keep it viable and responsive to the needs for data/record communications into the 1980s.

a. CONUS. An expanded memory system has recently been installed at the eight CONUS and one Hawaii switching centers because it was determined that these ASCs would have been out of core following the next major assembly. The expanded memory system, which consists of four disc units and two mini-computers at each switch, frees up core space necessary for additional programs, provides faster cycle time than the old mass memory units, and the new software package will allow for a larger operating program through program overlays. Another CONUS AUTODIN support project is replacement of the magnetic tape and mass memory units with disc units at each ASC. In addition to a $4 million cost savings over an eight year life, this enhancement will provide the needed direct, high-speed, channel interconnect to the AUTODIN II PSNs.

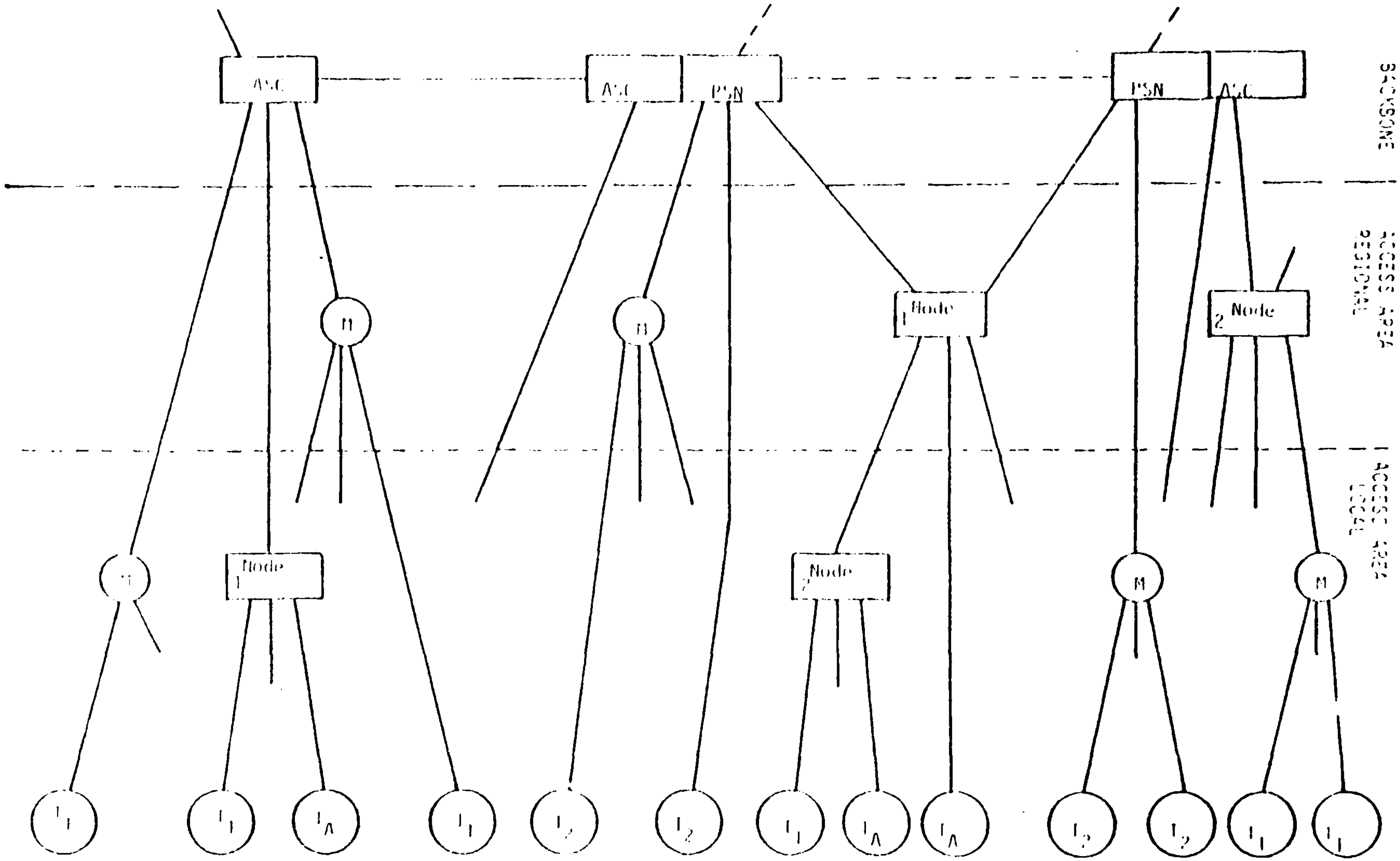


Figure 3 1980 Baseline Architecture

Legend

ASC - AUTODIN Switch Center

PSN - Packet-Switch Node

M - Multiplexer

T - Terminal (Source/Destination of Traffic)

T_1 - AUTODIN I Terminal

T_2 - AUTODIN II Terminal (including host computers)

T_A - AMPE

Node - AMPE

--- - Packet Backbone Trunks (up to 56 kbps)

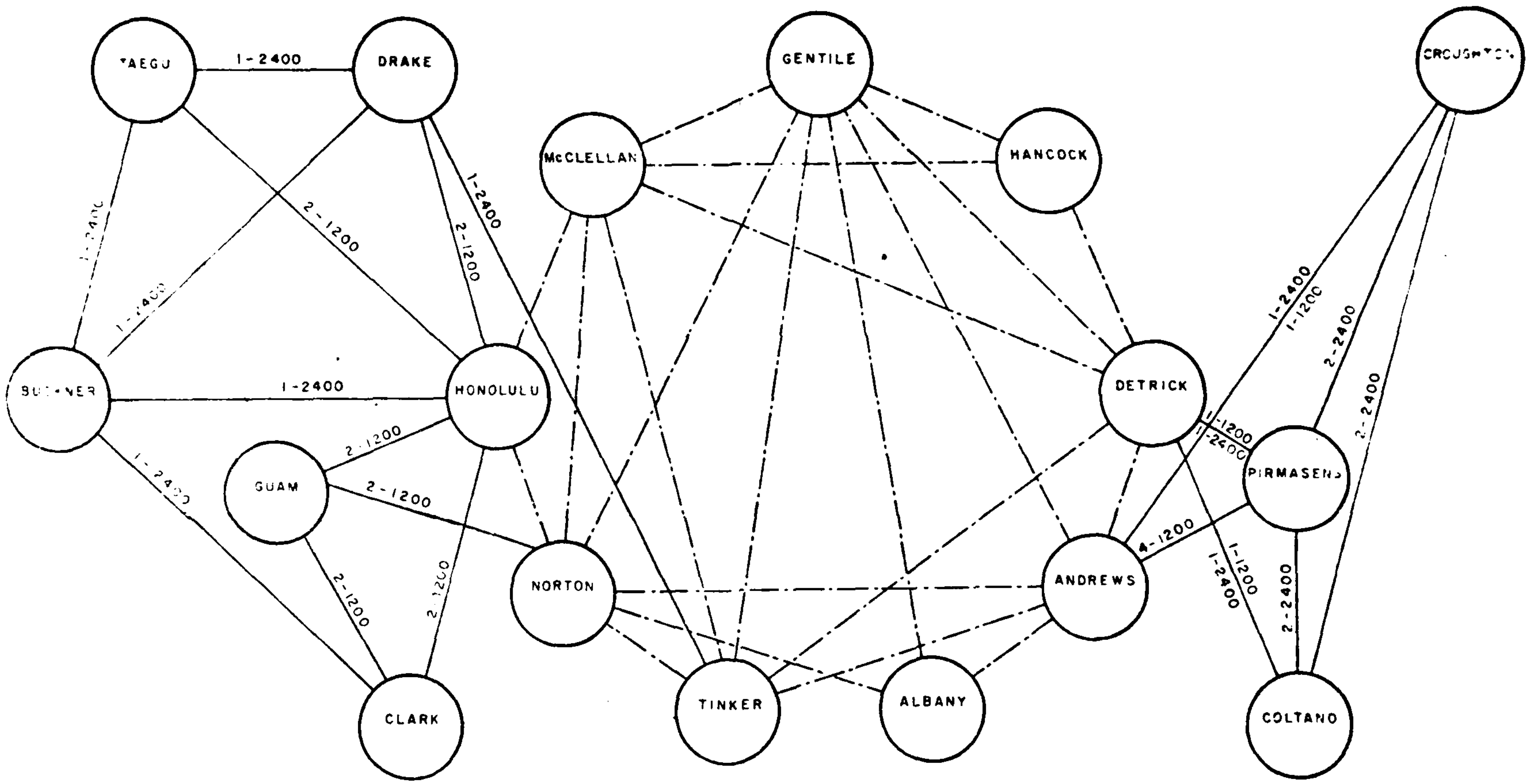
___ - Non-Packet Backbone Trunks (up to 9.6 kbps)

Footnotes

1. Immediately prior to 1980 and for a period following, the access area nodes will be some form of AMPE.

2. Access area nodes can be terminated on either ASCs or PSNs and overseas ASCs will be trunked to CONUS ASCs.

Figure 3. Continued



DECEMBER 1977

AUTODIN CONFIGURATION
Figure 4

LEGEND
O = SWITCHING CENTER
——— = INTERSWITCH LINE
3-1200 = 3 CHANNELS EACH 1200 bps
—·— = 2 CHANNELS EACH 4800 bps

b. Overseas. To meet current forecasted operational requirements and to replace/refurbish worn out subsystems of Overseas AUTODIN I, DCA has initiated several replacement projects. They are memory/memory control replacement program; input/output controller, card reader, and high-speed printer replacement; tape subsystem replacement; patch and test facility upgrade; NATO TARE interconnection, and minor system engineering modifications. These enhancements will insure operation of the overseas AUTODIN through at least 1985.

2. AUTODIN II. The AUTODIN II is a general purpose data communications packet switched network for integrating the teleprocessing and record communications needs of DoD into a single digital backbone system.

a. CONUS. AUTODIN II Phase I has an Initial Operational Capability (IOC) of FY 1979 to include four PSNs with options for four or more additional PSNs.

(1) Network Characteristics.

(a) The design of the AUTODIN II Phase I system is based on packet-switching technology with the intent to use fully those aspects of the ARPANET design technology, such as proven algorithms, that are applicable to the new system. The system will employ a short data handling unit, or packet of bits, to accommodate man-computer, computer-computer and/or computer-terminal data traffic.

(b) Each packet switch will perform the following basic functions: route and distribute packetized traffic (interactive, query-response, record, and bulk-data) over a full duplex wide-band trunking network; electrically interface with the AUTODIN I system through CONUS ASC's; terminate up to 150 lines (both individual and multiplex) per switch with a capability to service up to several hundred data subscribers; and accommodate dial-up access lines for low volume subscribers and emergency restoration.

(c) The initial network will consist of three PSNs at Ft. Detrick, Tinker AFB, and McClellan AFB with a Network Control Center at Headquarters DCA. The acceptance of this three node network establishes a FY 1979 IOC. Two months later, a fourth PSN will be added at Gentile AFB.

The growth of the network from that point will depend on user requirements and the dates they can provide the necessary software and hardware interfaces to connect to the network. It is envisioned that the network service will grow incrementally, as required, to meet additional requirements.

(2) Network Access.

(a) There are two basic types of subscribers to the AUTODIN II: network hosts and terminals. Hosts are computers which are capable of simultaneously conducting multiple conversations with other hosts or terminals. Host computers, in general, are the centers of major ADP teleprocessing systems and are major sources of network traffic.

(b) Terminals are defined as either bit or character oriented devices capable of conducting a conversation with only one destination at a time. Terminals input to the packet switching network interactive (I/A), query/response (Q/R), bulk, or narrative type applications. Terminal devices may be computer peripheral controllers and intelligent or unintelligent input/output devices. The PSN will interface with terminals so as to minimize the hardware and software impacts on these users. Multiplexers are used extensively in this network to minimize the cost for access lines.

(3) Data Flow. In this typical network data flow, the traffic source (computer, terminal, or AUTODIN II) will present a data segment to the source PSN. The source node will accept traffic a segment or character at a time from a subscriber, make prescribed control, security and community of interest checks, format the segment into a packet for network transmission and send each packet separately into the network on the appropriate trunk. Intervening nodes would relay the packets. The destination node will reform each packet into subscriber deliverable traffic in the form of a segment, perform outgoing validation checks, deliver the segment or characters to the destination terminal and acknowledge receipt.

(4) Privacy and Security. One-half of the ADP users have a requirement to transfer information which may be sensitive in terms of national security and/or proprietary in nature (to the user community). To meet this need, the AUTODIN II Phase I system link and switch facilities will be secured to the highest classification level transmitted, and will be capable of being compartmented by use of transmission control codes (TCC) and virtual logical channels. Each data packet will be verified as to the authorized security level and community-of-interest of both the sender and receiver.

b. Overseas. AUTODIN II Phase II is defined as the overseas portion of the PSN implementation scheme. An IOC of FY1983 has been identified in the DCS Five Year Program (FYP) 1980 for providing additional PSNs on a worldwide basis. Under this concept, in the 1980 time frame multiplexers would be located overseas to reduce access line costs, and as new requirements are identified, PSNs would be located overseas. An alternative approach to multiplexing is to install PSNs overseas in the 1981 time frame. Further discussion on these alternative is provided in this Section under the sub-heading Implementation Alternatives.

3. <u>AUTODIN I/II Relationships</u>.

a. Roles. The need for record/narrative message services provided by AUTODIN I is expected to remain stable through the implementation period of AUTODIN II Phase I. AUTODIN I will use the packet-switched backbone system established in AUTODIN II Phase I for all CONUS trunk transmissions. The current interface of the overseas AUTODIN I network will be through current CONUS AUTODIN I ASC's. AUTODIN I service will be enhanced by the inherent speed and interoperability capabilities provided by the AUTODIN II transmission system; however, AUTODIN II will be transparent to current AUTODIN I user procedures and formats. Prior to cutover of AUTODIN I traffic and deactivation of existing AUTODIN I trunking, the packet switched system will be fully verified by operational testing to insure that the traffic of both AUTODIN I and the packet switch subscribers are not impacted by use of common trunking.

b. Comparison. The similarities and differences between AUTODIN I and AUTODIN II are summarized in Table 1.

(1) AUTODIN II features a higher bandwidth for trunks and (selectively) higher bandwidth for access circuits. The small packet size permits low delay and high throughput characteristics. The low delay characteristic permits much better Q/R service, since the queueing delays at the switch node are sharply reduced. The higher bandwidth permits high throughput for bulk traffic, including computer communications.

(2) Some features of AUTODIN I are not accomplished in AUTODIN II, since the Packet Switch Nodes (PSN) of AUTODIN II do not provide for storage of messages. No record is maintained of traffic handled as this becomes a user responsibility. In addition, the PSN does not provide the capability of handling multiple/collective addresses accomplished in AUTODIN I.

4. Implementation Alternatives. In order to satisfy the user demands for service and to insure a level of spare capacity to meet contingencies and survivability at a level equal to today's requirements, an analysis of alternatives is provided of the number and location of AUTODIN I ASCs and AUTODIN II PSNs. The backbone switches are analyzed by CONUS and overseas applications. To reduce the repetitive analysis of similar items within the three alternatives presented, the approach is to evaluate each item only once and then refer to this item analysis within the other alternatives. Three potential networks are postulated and examined as implementation alternatives.

a. Alternative 1. Four PSNs/eight ASCs in CONUS; three ASCs in Europe; five ASCs in the Pacific. The interconnection of this network is postulated in Figure 5.

(1) CONUS. Four PSNs will be the initial operational capability of AUTODIN II, Phase I and these are planned to be in operation in 1979. An additional four PSNs are approved for implementation, if requirements for them exist. This particular configuration alternative

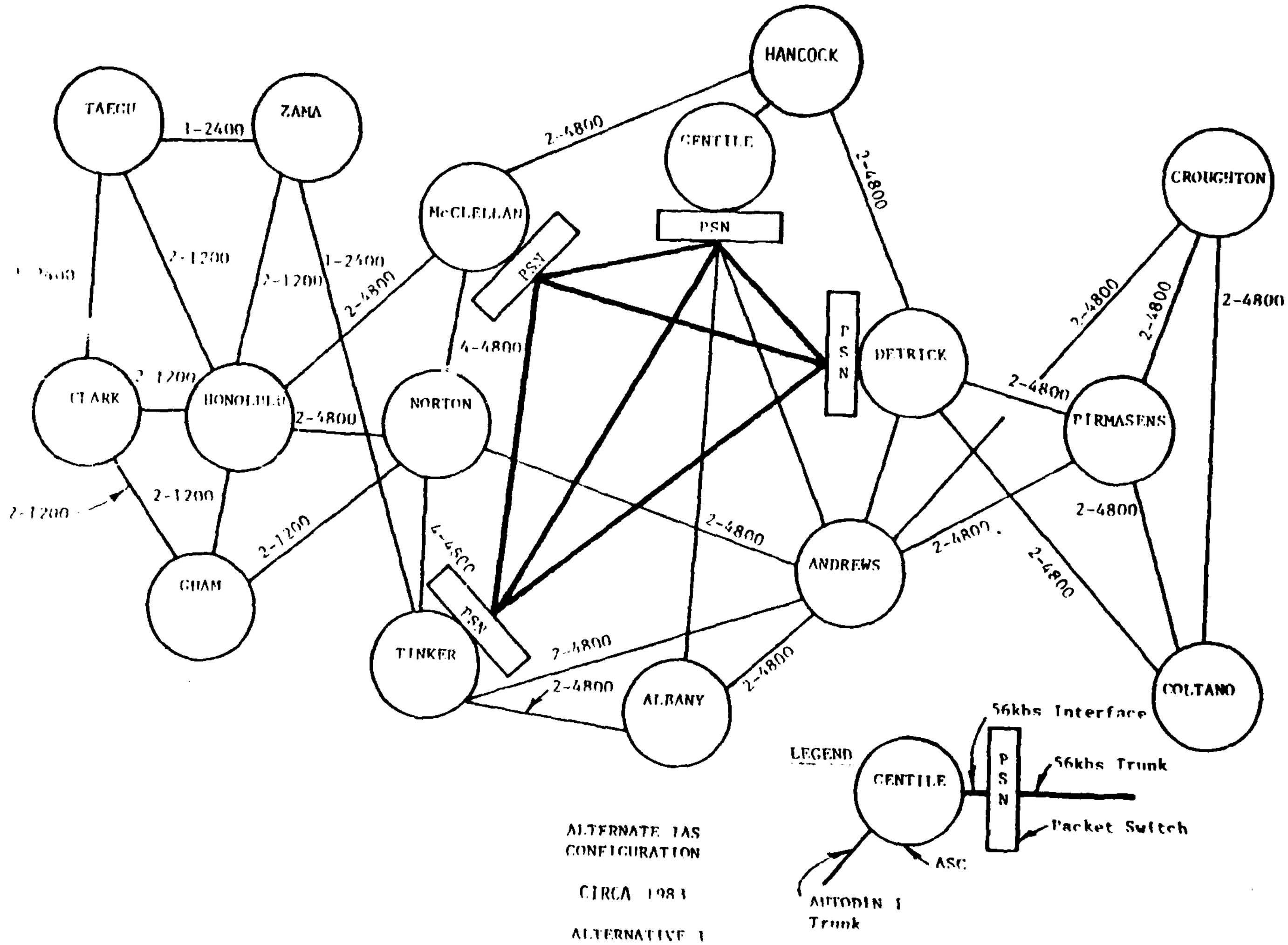
TABLE 1

AUTODIN I/II FUNCTIONAL COMPARISON

CHARACTERISTICS	AUTODIN I	AUTODIN II
Common User System	Yes	Yes
Store-and-Forward	Yes	No
Packet Switch	No	Yes
Modes of Operation	3	4
Message Accountability	ASC	User
Precedence Processing	Yes	Yes
Security Classifications Processing	Yes	Yes
Journaling	Yes	No
Format & Code Conversion	Yes	Limited
Multiple & Collective Addressing	Yes	No
Dual Homing	Yes	Yes
Interactive	No	Yes
Query/Response	Limited	Yes
Bulk Traffic	Yes	Yes
Guaranteed Sequential Delivery	Yes	No
Facsimile	Yes	Yes
Privacy	Yes	Yes
Language Media		
Data	Yes	Yes
Narrative	Yes	Yes
Message Integrity	Yes	Yes
Standards for Reliability	99.5%	99.95%

TABLE 1 (CONTINUED)

CHARACTERISTICS	AUTODIN I	AUTODIN II
Error Control	Block Parity and Retransmission	FIPS Algorithm (32 bit CRC)
Access Lines/Switch	250 max	150 max
Manning Overhead	100/switch	10/switch with existing ASC
Storage	Full Message	Packet
Processing Speed LBs/Sec	250	744
Bandwidth Limitations - Access Lines	4800 bps	56,000 bps
Routing Techniques	Deterministic	Adaptive
Inherent Delays	Minutes	Seconds
Buffering	Full Message	Packet
Message Lengths (max)	500 lineblocks	625 char/packet
Types of Subscribers-Mode	I, II, V	I, 1B, IIA, VI
Transmission Media - Trunks	4800 bps	230,000 bps
Network Control	NCC/MILDEPs	NCC
Vulnerability/Survivability	8 CONUS	4-8 CONUS
Encryption Scheme	Link	Link



ALTERNATE IAS
CONFIGURATION

CIRCA 1983

ALTERNATIVE 1

FIGURE 5

speculates that either the requirements for additional PSNs will not materialize, the funding will be withheld, or some other unforeseen occurrence will happen such that the system maintains only the four initial PSNs. The locations for these nodes have been specified as Ft. Detrick, Tinker AFB, McClellan AFB, and Gentile AFB. The eight ASCs shown in Figure 5 currently exist and would remain as configured.

(2) Europe. Figure 4 shows the configuration of the three ASCs in Europe today. The first alternate configuration (Figure 5) for the 1983 IAS shows the same three ASCs with enhanced trunks between the European ASCs and between Europe and the CONUS. This is due to the near term increase in requirements for 4800 baud terminations in Europe. The present day use of the European trunks is high and it is planned to use a biplexed 9600 bps modem to provide dual 4800 bps service where required.

(3) Pacific. The current Pacific configuration is shown in Figure 4. Figure 5 shows the IAS configuration for circa 1983 and reflects that the Buckner ASC will be placed in caretaker status by 15 January 1978 and the Camp Drake ASC will be relocated within Japan. This relocation is being accomplished to achieve a lower overall O&M expense. Alternative 1, Figure 5, envisions a set of requirements that remain fairly constant or increase slightly. The Pacific is somewhat unique in that the ASCs are to the greater extent servers of in-country needs for subscriber terminals. As such, political/military decisions with regard to our presence in a particular territory dictate both the presence of the subscriber terminals and the ASC. Removal of an ASC without removal of the subscriber terminals could place a burden on the inter-country transmission facilities. The cost of transmission in the Pacific is high due to the current cost being proportionate to distance. The availability of transmission facilities also is a problem in part of the Pacific. The requirements are generally met by high efficiency multiplexers when subscriber access lines are extended inter-country. A study is underway which will determine how the AUTODIN will serve CINCPAC in the near term. The results of this study will be available in May 1978.

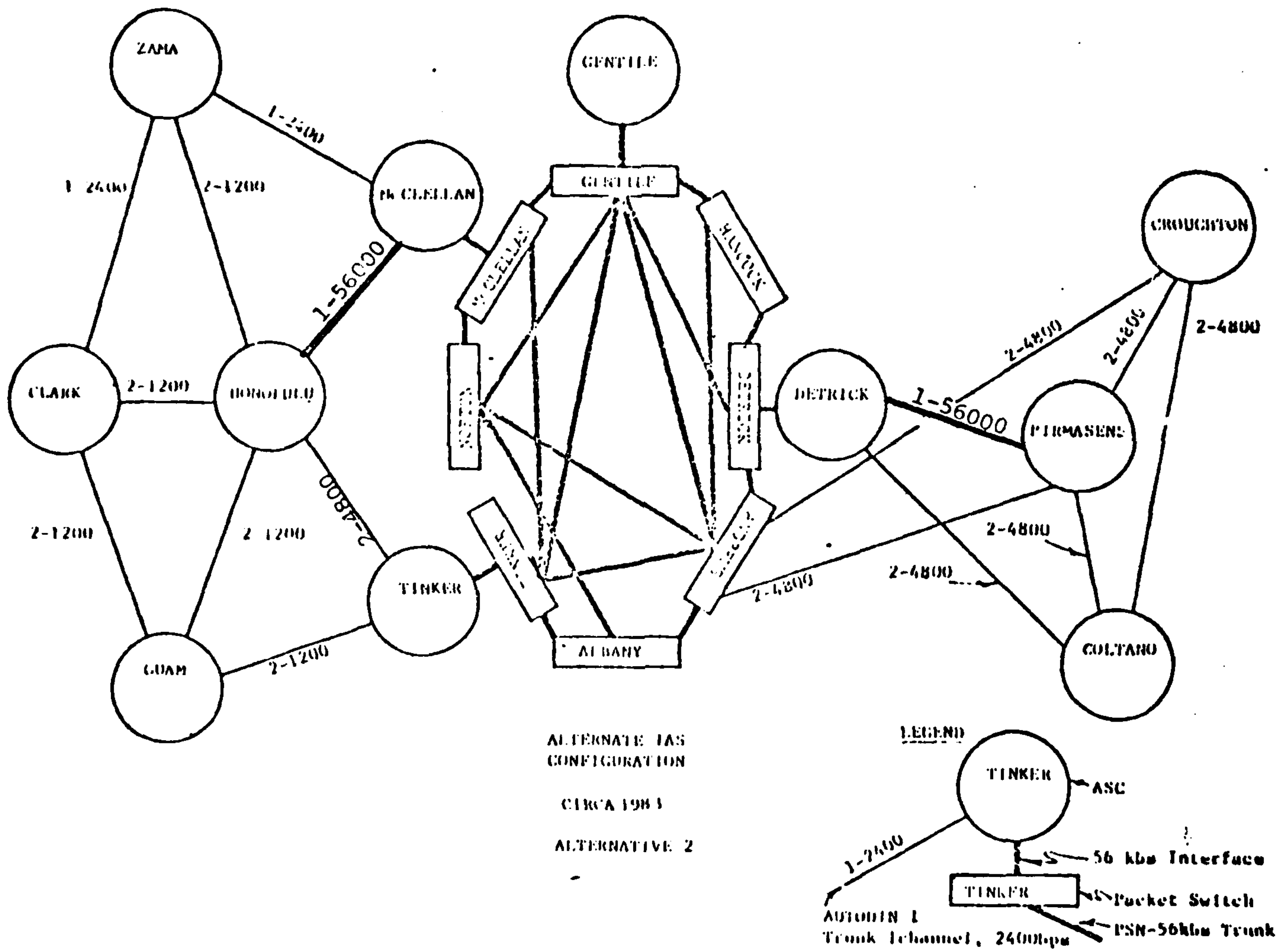
b. Alternative 2. Eight PSNs/four ASCs in CONUS; three ASCs in Europe; four ASCs in the Pacific. Figure 6 depicts an alternate IAS configuration for the 1983 time frame. It features completion of the eight node AUTODIN II Phase I packet switching network in CONUS. In addition, it postulates that four of the eight ASCs in CONUS have been closed as projected in the AUTODIN II DCA Business Plan. The European configuration is identical to the first alternative. The Pacific configuration shows the closure of an additional ASC. For planning purposes, the Taegu ASC is projected as closed; however, the pending results of the Pacific reconfiguration study may alter the ASC closure selection.

(1) CONUS. Figure 6 depicts the Andrews, Hancock, Norton, and Albany ASCs as closed. The DCA AUTODIN II Business Plan projected the closure of Hancock, Albany, Tinker, and Gentile ASCs; however, the above closures are more logical because the remaining ASCs provide better geographic coverage. Only the low speed circuit miles are affected by the choice of which set of ASCs are closed, and these differences can be reduced by employing Time Division Multiplexers.

(a) Factors Affecting ASC Closures. Requirements in terms of the number of subscriber connections needed, total traffic in the busy period, and the Services and Agencies plans for use of AMPEs are important factors affecting the required collective capabilities of the ASCs. The ability of the individual ASCs to terminate subscribers, the capacity of AUTODIN I/AUTODIN II interface, and the throughput capabilities required to handle the traffic are the major technical constraints on closing ASCs. The economic factors involved are the costs savings realized by closing an ASC, including leased cost, personnel savings, and base support costs.

(b) Integration of ASCs and PSNs. At a collocated ASC/PSN facility any integrated patch and test operation will be implemented with management/administrative and crypto maintenance functions absorbed by the current ASC personnel. An additional ten personnel, will be provided for operation of the PSN on a 24 hour basis. The closure of AUTODIN I ASCs is dependent upon how effectively the interface to the AUTODIN II PSNs is implemented.

1. Contract negotiations to make changes in the AUTODIN I ASCs to allow for a high speed interconnection to AUTODIN II are in progress. The ability to bypass the Accumulation Distribution Unit (ADU) is critical to the ability to close ASCs. Currently the number of subscribers that can be terminated on an ADU is limited



ALTERNATE IAS
CONFIGURATION

CIRCA 1983

ALTERNATIVE 2

FIGURE 6

by the capacity of the Data Memory. The amount of memory used per subscriber varies with speed. A 2400 or 4800 bps trunk or tributary requires 28 lineblocks of storage; a low speed tributary requires 6 lineblocks. The data memory CONUS wide is currently 75% used. It can be observed that if half the ASCs were closed, the remaining ASCs Data Memory would be 50% oversubscribed. With the advent of a suitable direct interface between AUTODIN I and II, this limitation can be overcome. Current proposals call for interfacing via dual 56 kbps duplex serial communications channels, operating in Mode VI (i.e., the proposed ADCCP standard). This interface will terminate in the AUTODIN I PDP11/34, which was added to AUTODIN I CONUS to facilitate mass storage requirements.

2. A limitation on an ASC's ability to terminate more subscribers is in the ability of the ASC to throughput the traffic. Throughput is a capability which is affected by a seemingly unlimited number of variables, therefore, the throughput ability changes with every program improvement and its exact value is unknown. A network simulation of four ASCs in CONUS was analyzed to determine the maximum throughput that would be required of an ASC. The ability of an ASC to throughput is a critical factor to reduce the number of CONUS ASCs from eight to four. The simulation used current traffic loads. The peak demand was experienced at the Fort Detrick ASC for which there was an average of 217 line blocks per second (lb/s) over a 15 second period. The other three ASCs experience peaks of 213, 215 and 174 lb/s. In that the ability of an ASC to throughput data is estimated at 200 lb/s ± 50 lbs, the ability of a four ASC network is in question.

(c) Cost. The DCA Business Plan for AUTODIN II Phase I contemplated the closure of Hancock, Albany, Tinker, and Gentile ASCs. In the simulation and rehoming plan developed for the four switch closure study, the Tinker and Gentile ASCs were retained and Andrews and Norton ASCs replaced them. Refer to Table 2 for the estimated AUTODIN I Switch Closure Savings.

TABLE 2

AUTODIN I SWITCH CLOSURE SAVINGS

(TABLE DELETED)

(d) Approach. The approach to implementing this alternative is to reterminate AUTODIN I subscribers which are Mode I to a PSN and use the packet network to extend the termination to a distant ASC via its collocated PSN to achieve a home ASC for subscribers. Reference is made to Table 3.

1. A data base was prepared which contained all the present AUTODIN I subscribers, their coordinates, speed, present ASC and dual homed pair identity if they had one. The data base was updated with recent data from the Agencies and MILDEPs to include their projected AMPE connectivity to the ASCs and the current ASC subscribers that will be moved (projected at 127) to the backside of AMPEs by 1980. The validity of the data base was tested against the AUTODIN Monthly Summaries.

2. With data base the distance from each subscriber location to the nearest ASC or PSN was determined. Each subscriber was then placed on an ASC or PSN in the four ASC, eight PSN configuration. All the low speed subscribers were placed first; the 45 and 75 baud subscribers were placed on the nearest ASC. The amount of data memory being committed for each tributary was recorded in the event the ASC became over subscribed. The difference between current homing and proposed homing in terms of access circuit miles was also computed. The placement was completed without over subscribing any ASC. The subscribers who were placed on the PSNs were not assigned a home ASC. This remained to be done manually. In cases where dual-homed

subscribers were encountered, the algorithm placed them on the two nearest facilities. Based on this analysis, there were 51 less subscribers present in the network. This is the net loss due to movement of tributaries to the backside of AMPEs and the addition of AMPEs as tributaries of the ASCs. The Andrews, Norton, Albany, and Hancock facilities are PSNs and as such have less subscribers because they have no 45 and 75 baud tributaries. If this was not recognized, the conclusion could be reached that they are without doubt the least used facilities.

(e) Timing of ASC Closures. Alternative 2 describes the network after eight PSNs have been installed and four of the original eight ASCs have been closed. To transition from the current AUTODIN configuration to the Alternative 2 approach, the recommended method is to install the four initial PSNs, test them out operationally, and then close one ASC. Then, as each additional PSN (fifth through seventh) is installed the collocated ASC would be closed. This <u>incremental ASC closure</u> scheme will provide sufficient opportunity to check out the throughput capability on the remaining ASCs without adversely impacting the user service. For the latter three ASC closures, the AUTODIN I Mode I subscribers would be connected to the PSN (using the same access lines) and the PSN network would home them to one of the remaining ASCs. The integrated network would contain no less than eleven switches at any one time and in the final configuration, the original eight CONUS locations would have switches. Maintenance of this number of nodes is important to the survivability of the network. Because the access lines are not disturbed, little or no change is felt by the Mode I subscribers and costs for their access lines remain constant. If expansion from the four node PSN network to the eight node network proceeds slowly (awaiting requirements or money) it would be unwise and of suspect profitability to close additional ASCs until PSNs are installed. Not only would the availability be lessened, but because the facility would not have a collocated PSN, its tributaries would require new and longer access lines (at additional cost to the Services and Agencies). This situation would persist until a PSN was installed at the former ASC facility. While some cost benefit could be attributed to installing a PSN in a facility after an ASC has been closed, these savings are not so great as to outweigh the operational upheaval multiple access line reconfiguration would cause the subscribers.

		PSNs & ASCs				
		GENTILE	DETRICK	TINKER	MCCLELLAN	TOTAL
PSNs ONLY	ANDREWS	28	58	2	0	88
	NORTON	1	0	18	24	43
	ALBANY	6	0	43	0	49
	HANCOCK	45	0	2	0	47
	TERMINALS HOMED VIA PSN	80	58	65	24	227
	DIRECTLY CONNECTED TERMINALS	100	145	131	125	501
	TOTAL TERMINALS BEING SERVED	180	203	196	149	728

FOUR ASC CLOSURE

AUTODIN I TERMINAL REHOMING PLAN

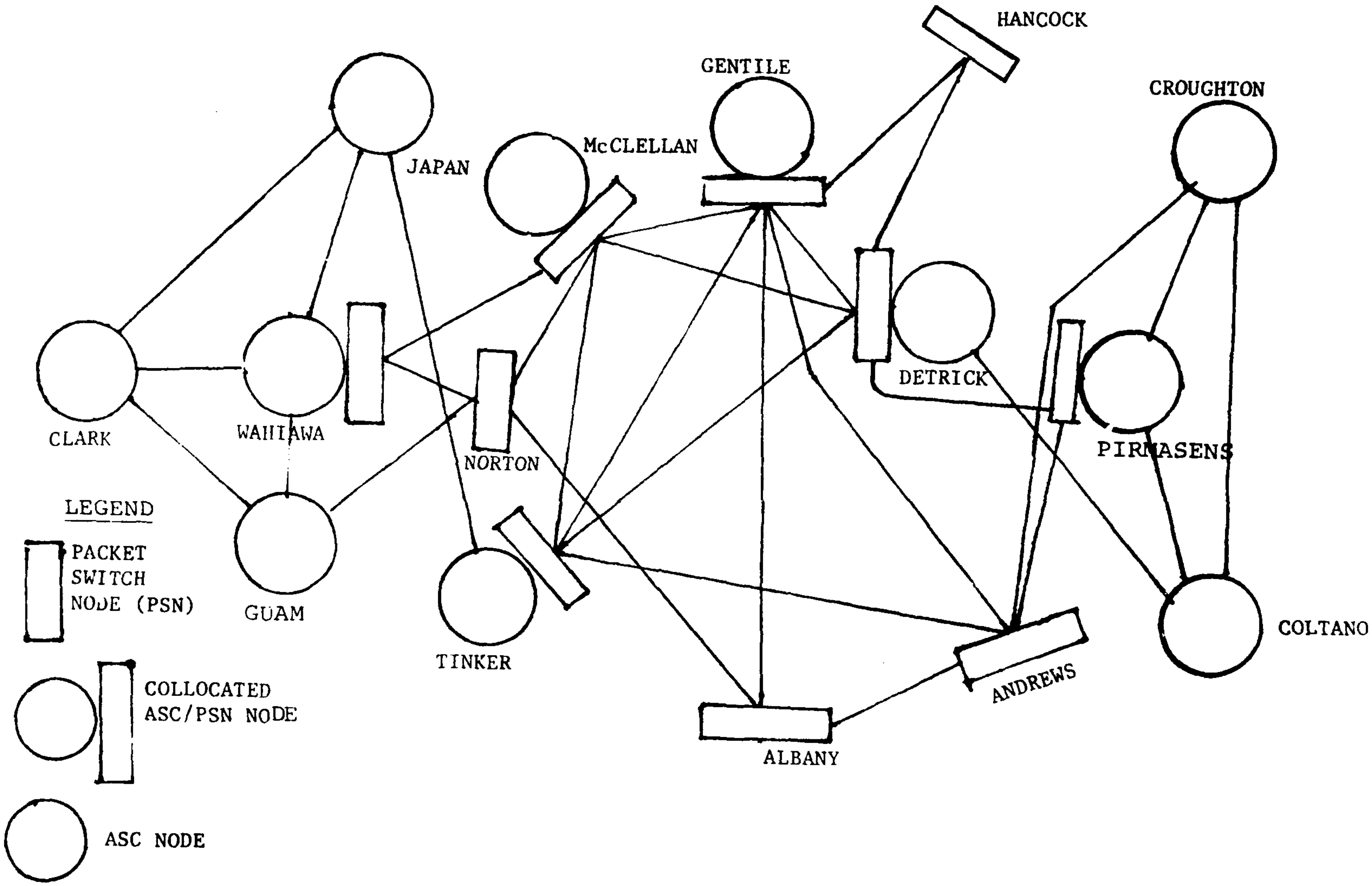
TABLE 3

(2) Overseas. The European configuration is the same as the current configuration, namely, ASCs at Croughton, Pirmasens, and Coltano, with some minor exceptions on transatlantic trunk speeds. Pacific onfiguration shows the closure of an additional ASC with remaining ASCs in Japan, Guam, Philippines, and Hawaii. AUTODIN II overseas requirements would be served with the CONUS based Phase I system. Multiplexers would be located overseas to reduce access line costs. Then as requirements increase, PSNs would be located overseas.

c. Alternative 3. Eight PSNs/four ASCs in the CONUS; three ASCs/one PSN in Europe; four ASCs/one PSN in the Pacific.

(1) CONUS. Alternative 2 discusses the eight AUTODIN II Phase I PSNs in CONUS; in addition, it postulates the closure of up to four ASCs in CONUS. Since the CONUS configuration remains the same, only the overseas PSN alternative will be discussed herein.

(2) Overseas. There are several viable options or alternatives for implementation of AUTODIN II packet switching overseas, both from a method, as well as a location point of view. Prior to analysis of the various methods of extension, a brief analysis of locations is in order. Figure 7 shows that overseas PSN implementations are collocated with AUTODIN ASCs as in AUTODIN II CONUS. Further, the collocations are shown at the Pirmasens ASC in Germany, and the Wahiawa ASC in Hawaii. Survivability considerations must be evaluated in the determination of final site locations. Locations of the PSNs collocated with the ASCs presents a question in the survivability area, i.e., "all the eggs in one basket." With the basic site locations recommended, it is now possible to postulate alternatives for implementation. The initial extension of AUTODIN II overseas in envisioned as being a small or reduced representation of th full scale capability. A full scale AUTODIN II PSN is capable of handling from 50 up to 150 terminations, consisting of either individual or multiplexed lines. Overseas requirements, as discussed in Section II, are reduced from this capability. Accordingly, the overseas implementation would be of the small type configuration. Figure 7 postulates European and Pacific implementation configurations with an eight PSN CONUS network. Both overseas PSNs would be homed on two CONUS PSNs, and the collocated ASC could derive its CONUS connectivity through the PSN. With a reduced PSN implementation, trunking from the overseas PSNs would be a packet trunk to a PSN and a Mode I trunk to an ASC.



IAS CONFIGURATION - ALTERNATIVE 3

FIGURE 7

PSNs overseas can be obtained through various means. They include the use of existing installations augmented by a software package to perform the PSN functions, development of a new family of nodal equipment/software, procurement of additional CONUS type PSNs for overseas deployment, Government purchase and installation of CONUS type AUTODIN II hardware, as well as various additional combinations/permutations of these approaches. The option selected as offering the most realistic opportunity is the GFE purchase and installation of CONUS type AUTODIN II hardware. The Government could provide the hardware overseas and, owning the AUTODIN II software, load the CONUS software package into the overseas installations. This approach requires funds for Government procurement, which is now under study by the AUTODIN II Program Manager.

(a) Cost Implications. The WSEO paper "A Transition Strategy Study to Interconnect WWMCCS ADP Systems." April 1977, provides a meaningful cost analysis for justification of the European PSN. Connectivity to the overseas sites will require multiplexers and lines outside of CONUS to allow all traffic to be "back hauled;" that is a message sent from one European location to another European site would cross the Atlantic and then return to the destination site. Communications costs for WWMCCS ADP in the PACOM and EUCOM areas were further analyzed under this condition. The study showed if dedicated lines were used for access to European commands with multiplexers in Europe, approximately (DELETED) would be required annually for connection to the AUTODIN II network in CONUS. However, if an AUTODIN II PSN was installed in Europe, communications cost to WWMCCS ADP would be reduced to (DELETED) As it would cost approximately (DELETED) to install a PSN in Europe and as WWMCCS ADP use alone almost justifies its cost, it appears logical to install an AUTODIN II PSN in Europe providing additional user requirements can also be satisfied. Likewise, a (DELETED) in WWMCCS ADP connectivity costs is obtained if an AUTODIN II PSN is installed in Hawaii. If sufficient other user traffic existed in the Pacific, installation of an AUTODIN II PSN in the Pacific could also be warranted. Refer to Section II. D. for system requirements.

(b) Schedule. It is estimated that PSNs overseas could be implemented in the 1981 timeframe. Scheduling of the overseas AUTODIN II PSN approach is highly contingent on the CONUS schedule and activation of contract options. A four PSN network is being provided, with options for four or more additional PSNs. Expansion to overseas could be through use

of two of the four expansion systems which would reduce the overall schedule and could provide earlier implementation of PSNs overseas. If no options are available, then it is estimated a minimum of 12 months would be required just to acquire the systems. Analysis is underway to develop the users needs data base for overseas PSNs. The result of this analysis will be available by August 1978, at which time a decision on early implementation of overseas PSNs will be made.

d. Conclusions. Three alternatives are presented to provide the best balance between services offered, cost to users and overall government expenditures.

(1) Alternative 1 provides the required backbone switch services in the CONUS, but it does not identify any AUTODIN I ASC closures resulting from implementation of AUTODIN II PSNs. Also, it does not offer AUTODIN II service to satisfy overseas requirements.

(2) Alternative 2 extends the AUTODIN II program in the CONUS and provides an incremental ASC closure approach to allow sufficient time to test the throughput capability on the remaining ASCs. Also, it provides AUTODIN II overseas service through multiplexing of traffic to the CONUS based system.

(3) Alternative 3 provides the same AUTODIN I backbone switch configuration as Alternative 2. The difference in this alternative is the location of PSNs overseas versus using multiplexing. Although PSNs overseas would satisfy requirements, it is not cost effective when compared to multiplexing to the CONUS. Documented user requirements do not now dictate the installation of PSNs overseas.

(4) Based on the three alternatives, it is concluded that with implementation of eight PSNs, it is feasible to close up to four CONUS ASCs. Also, further study is needed to justify the implementation of PSNs overseas.

e. Recommendation. Alternative 2 be selected as the implementation alternative for backbone switches.

C. Access Area Exchanges.

1. Definition. AUTODIN is a system that by definition includes the ASCs, interswitch trunks, terminals and access lines. Until recent years, the ASCs were the only really automated elements of the system doing such things as switching traffic, storing it, maintaining history, etc.---all automated. Recently, telecommunications center functions

became increasingly more automated and AUTODIN terminals were developed that started looking and acting like AUTODIN switches. These terminals are called by various names such as Local Digital Message Exchange (LDMX), Naval Communications Processing and Routing System (NAVCOMPARS), Automated Multi-Media Exchange (AMME), Automated Telecommunications Program (ATP), and STREAMLINER. In May 1976, MOP 165 was revised to provide guidance on the role these Automated Message Processing Exchanges (AMPEs) - generic term for LDMXs, NAVCOMPARS, AMMEs, ATPs, and STREAMLINER - should serve in the AUTODIN system.

2. AMPEs. These systems were designed and developed independently by the Services and Defense Agencies as a means of exploiting the benefits of automation and as a means of complying with Congressional guidance to reduce manpower, support costs and the time required to process and transmit messages. Each system included in its design specifications certain functions and features which were considered necessary to the accomplishment of the mission or which reflected the telecommunications philosopy prevalent at that time. As a result, the various AMPE systems are in many respects similar; in other respects they differ as widely as the missions to be performed. The time frame in which the systems were designed, with subsequent changes in Defense priorities as well as significant techological advances in the fields of telecommunications and automation have accentuated the differences in the AMPEs as they exist today. The following AMPE systems have been studied for potential standardization: LDMX, NAVCOMPARS, AMME, ATP and the STREAMLINER. The Defense Logistics Agency (DLA) AMPEs were excluded in the study because of the specialized nature and estimated useful life of the equipment. The Air Force Intermediate Capacity Automated Telecommunications Systems (ICATS) were not included because the data submitted did not indicate that these AMPEs performed all of the 32 evaluated functions.

a. LDMX and NAVCOMPARS.

(1) Background. The Naval Telecommunications Automation Program (NTAP) was developed subsequent to a DoD study of 1967 which recommended the development of LDMXs. The Subsystem Project Plan (SPP) for the NTAP was submitted to OSD in early 1969. In this SPP Navy combined the requirement to automate telecommunications services provided to large shore stations and the requirement for automating fleet telecommunications. The resulting contract was to UNIVAC in December 1970 to provide 6 LDMX I and 4 NAVCOMPARS I using UNIVAC 70/45 equipment. Refer to Appendix 2 for equipment characteristics. The NAVCOMPARS

performs all the functions of the LDMX and also provides a marked improvement in ship to shore communications. Since the LDMX and NAVCOMPARS were specified in the same contract those features which exist to automate ship to shore communications and to maintain the records required of fleet broadcast have a strong influence on both systems. In 1974 the Navy identified requirements for additional automated systems which could not be satisfied with the UNIVAC LDMX contract. When Navy sought DoD approval of a follow-on LDMX contract, DTACCS directed that Navy procure the required additional hardware from the UNIVAC AMME contract with the U.S. Army.

(2) Description. The LDMX is an AMPE used for interface with AUTODIN to meet requirements for distribution of on-base record communications by a naval telecommunications center or message center serving fleet commands based ashore, and shore (field) activites in naval station/base complexes. NAVCOMPARS, in addition to providing all LDMX capabilities, also provides for the interface with Navy tactical environments.

(3) Status. Six LDMX Is and four NAVCOMPARS Is are operational with two test beds. The current NAVCOMPARS I equipment will be replaced with NAVCOMPARS IIs, UNIVAC 90/60 equipment, freeing the U70/45 equipment for additional LDMX I installations. In addition, eight LDMX Is, two LDMX IIs, and one NAVCOMPARS II are planned.

b. AMMEs.

(1) Background. The AMME is the principal telecommunications system identified in the Army Telecommunications Program (ATCAP). The AMME was approved in October 1971 by OSD following DODD 4630.1 action by Army. The resulting contract with UNIVAC in 1973 provided attractive discounts (25%-65%) if 24 systems were procured. At that time Army had identified 27 locations for AMMEs.

(2) Description. AMME is designed to provide comprehensive and improved communications center services, including an AUTODIN interface in support of selected Army locations around the world.

(3) Status. Four AMMEs are operational, with one test bed, and an additional AMME at Taegu, Korea installed and undergoing operational tests. In addition to the six installed systems, Army has plans for 15 additional AMME installations.

c. ATP.

(1) Background. In May 1972, the Air Force

received initial approval for their program, which identified four levels of automation ranging from manual, medium, intermediate, and large capacity systems. These latter three categories of automation are defined as AMPEs and are included in the AMPE data base. In 1973, Air Force began revising the ATP to incorporate their concept of distributed processing through an array of mini processors. In 1975, DoD approved the Air Force 4630.1 action for the procurement of seven ATP systems.

(2) Description. The ATP provides for modularly-expandable mini-computer systems designed to be sized according to changing requirements.

(3) Status. Twelve automated systems are operational with one test bed. The contract for the ATP mini-computer systems was signed on 12 September 1977 with C3 Inc., and it allows for one test facility and six operational systems.

d. STREAMLINER.

(1) Background. In August 1973, the STREAMLINER program received approval for 32 systems. It was designed to automate the CRITICOM terminal, to reduce writer-to-reader time and to provide the benefits of automation to the SI field sites. More than any other automation program, STREAMLINER received its impetus from the Pueblo and Liberty incidents. These incidents focused attention on the handling of critical communications in particular and all intelligence communications in general. The STREAMLINER system is designed to provide the required communications automation at minimum possible cost.

(2) Description. STREAMLINER provides for automation for the telecommunications centers serving the Service Cryptological Agencies and NSA/CSS field activities. The system was designed to eliminate the manual recorded message processing functions performed in SIGINT telecommunications centers. DIrect electronic interface with computer based SIGINT mission systems is also provided. The system processes both GENSER (JANAP 128) and DSSCS (DOI 103) messages.

(3) Status. Twenty-six systems are operational. Five additional systems will be installed by March 1978.

e. Functional Comparison. A comparison of system characteristics and functions performed by the AMPEs is provided in Appendix 2. In this comparison the functions are categorized as follows:

(1) AUTODIN System Functions. This category includes those functions that are required of all terminals served by AUTODIN.

(2) Telecommunications Center Functions. This category includes those functions performed either manually, automatically or semi-automatically at all telecommunications centers.

(3) Customer Assistance Functions. These are functions which are not inherently telecommunications center functions, but which can be more efficiently performed at the telecommunications center than at the user facility.

(4) Physical Characteristics. Physical/electrical characteristics of the systems.

The Phase I AMPE functional comparison study concluded that there existed more commonality than disparity in system functions, and that total intersystem compatibility could best be achieved through a centrally planned and controlled evolution. In a follow-on study, a more detailed technical evaluation of the AMPE systems was performed. The study, termed the Phase II AMPE Comparison Study, provided an evaluation of each of 32 performed functions for potential standardization. Twenty-six functions were indicated as offering potential for standardization. The detailed analysis of these two AMPE studies are provided in Appendix 2. A third phase of the AMPE comparison analysis is now in progress. Its objective is the determination of the feasibility and cost-effectiveness of modifying existing AMPEs to provide functional standardization. In this phase, candidate functions will be selected from the three categories of functions previously analyzed. These candidate functions will be evaluated and a "strawman" standard for that function will be selected. The Services/Agencies will then analyze the impact of using the selected "strawman" standard for each of the candidate functions. THe IASA Technical/Policy Panel will then recommend whether it is cost-effective to standardize present and near term AMPEs. All three phases of the AMPE study effort are providing a definition of functions required to project a new generation of AMPE equipment, functionally specified as an Inter-Service/Agency standardized AMPE.

f. Profile. Table 4 provides a breakout of Service/Agency AMPEs into three categories: installed, approved for installation, and projected but not yet approved for installation.

TABLE 4

AMPE PROFILE

	Installed	Approved	Projected	Total
Army	6	2	13	21
Navy	12	2	9	23
Air Force	13	0	8	21
DLA	18	0	0	18
NSA	26	5	0	31
TOTAL	75	9	30	114

Of the total 114 AMPEs encompassing all Service/Agency programs, 39 remain to be installed through 1982. Of those 39 to be installed, only 9 have gone through formal installation approval, leaving 30 systems requiring approval. The AMPE installation schedule is shown in Table 5.

TABLE 5

AMPE INSTALLATION SCHEDULE*

	FY 78				FY 79				FY 80				FY 81				FY 82			
	A	N	AF	NSA	A	N	AF	NSA	A	N	AF	NSA	A	N	AF	NSA	A	N	AF	NSA
CONUS	1	1	1	6	2	2	3	0	2	2	3	0	5	2	5	0	0	3	5	0
EUROPE	1	1	0	3	1	0	1	0	2	0	0	0	1	1	0	0	0	0	0	0
PACIFIC	1	0	0	0	0	3	0	0	0	0	2	0	0	0	1	0	0	0	0	0
TOTAL	3	2	1	9	3	5	4	0	4	2	5	0	6	3	6	0	0	3	5	0

*The following notes apply to Table 5:

- During FY 1/78 5 AMPEs were installed (4 NSA and 1 Army).

- Navy figures reflect installation of 15 AMPEs during fiscal years 78-82; purchase of Navy AMPEs is limited to 7 (4 of which are for use in upgrading current NAVCOMPARS); the remaining 8 installations include re-use of LDMX equipment.

- Air Force's ATP implementation during FY 78 is one test bed system. Six ATP systems now under contract are projected to be installed beginning March/April 1979. Follow-on ATP system are projected to cost effectively replace UNIVAC 418II/III computer systems as well as to upgrade capabilities at designated locations to enable TCC consolidation and extension of automation.

- Contractual commitments incurred by the Army through the AMME contract will be satisfied through both Army and Navy equipment purchases as of FY 80. If the scheduled implementation is followed as shown above, the commitment will be satisfied by mid-1980.

Table 6 provides the AMPE procurement costs by fiscal year. Total program costs are not presented to include site preparation, software, logistics support and training.

TABLE 6

AMPE PROCUREMENT COSTS

(TABLE DELETED)

3. <u>Implementation Alternatives</u>. Based upon the completed AMPE functional comparison studies (Phase I/II) and the in-progress cost analysis study (Phase III), the following are AMPE implementation alternatives:

a. Alternative 1. Continue current AMPE Programs. Install the Service/Agency 39 AMPEs over the FY 78-82 time frame, at a cost approximating (DELETED)

b. Alternative 2. Inter-Service/Agency AMPE Program. There are two approaches to this alternative:

(1) Alternative 2A. Implement an Inter-Service/Agency AMPE program using available AMPE resources.

(a) After analysis of the AMPE Phase II Comparison Study data (Appendix 2), it was concluded that three AMPEs are viable candidates for near-term implementation as inter-Service/Agency AMPEs. These are the Navy LDMX/NAVCOMPARS, the Army AMME, and the Air Force ATP. The Streamliner, on the other hand, was designated to provide the minimum required automation of the CRITICOM network at the minimum possible cost, with austerity of the system influencing the available features and the manner in which the telecommunications functions are performed. Based on the above factors, the Streamliner is not recommended as a candidate inter-Service/Agency AMPE.

(b) If the AMPE Phase III Cost Analysis Study concludes that it is cost-effective to standardize present AMPEs then a standard inter-Service/Agency AMPE would be recommended for use by all DoD components.

(2) Alternative 2B. Implement an Inter-Service/Agency AMPE program based upon functional specifications to be developed by August 1979. These specifications could be used to enter a development phase from which industry could provide the hardware and software needed for implementation.

c. Conclusions. AMPE Alternatives 1 and 2, presented above, do not necessarily offer two divergent approaches to satisfying Service/Agency requirements.

(1) Alternative 1 offers the Services/Agencies the greatest degree of flexibility in satisfying their current and projected needs, but it does not facilitate the sharing of technology among the Services and Defense Agencies.

Standardization does offer the potential for reduction of cost and increased inter-Service/Agency interoperability, but it must be carefully controlled to ensure flexibility to meet changing user requirements and to incorporate new technology and techniques afforded by the continually changing state-of-the-art.

(2) Alternative 2 provides for an inter-Service/Agency AMPE program through one of two approaches, that is, using current AMPE resources or based on functional specifications to be developed by August 1979. The former approach offers a circa 1980 implementation schedule based on availability, while the latter approach has an implementation schedule in the 1983 time frame.

(3) From the AMPE functional comparison studies it is concluded that 26 out of 32 evaluated telecommunication functions have a high degree of commonality.

(4) An inter-Service/Agency AMPE program is viable, and the AMPE cost analysis study will aid in determining the access area AUTODIN architecture.

d. Recommendation. Alternative 2B be selected as the implementation alternative for AMPEs.

D. Terminals.

1. Definition. A user terminal is that input/output device which is the ultimate source and destination of the data traffic being handled by the network. All intermediate sources and destinations of traffic (e.g., an AMPE) are nodes where communications services are performed. Previously all subscribers directly connected to ASCs were lumped together as terminals without regard to their actual hierarchical status. Thus, AMPEs were labeled as AUTODIN terminals even though AMPEs function as nodes, not user terminals. (Note: It is possible that some devices may be labeled as AMPEs which perform user terminal functions in addition to the normal nodal functions associated with AMPEs.) Depending on functional use and hierarchical location, such a device will be functionally designated as either a node or a user terminal. Functional specifications for a "Common Family of AUTODIN Terminals" also apply to AMPEs.

a. User terminals are assumed to be duplex. Receive-only and transmit-only units will be dealt with on a case-by-case basis. Terminals include, as a minimum:

(1) Very simple duplex devices (e.g., teletypewriters);

(2) Controlled, hard-wired logic devices (e.g., Teletypewriter Control Unit/Teletypewriter AUTODIN I Mode V, and Digital Subscriber Terminal Equipment);

(3) Controlled, software programmalbe devices (e.g., DCT-9000 used as an AUTODIN I Mode I terminal, the Standard Remote Terminal (SRT) and microprocessor controlled, buffered terminals);

(4) Sophisticated software programmable processor capabilities (e.g., host ADP installations connected to AUTODIN II).

b. Supporting the traffic through the AUTODIN are a variety of terminals possessing certain parameters of speed, mode, and inherent automation of message processing functions. The following definition applies to the terminal parameters:

(1) Speed. The rate of traffic exchange between terminal and switch;

(2) Mode. The protocol by which traffic is transmitted from terminal to switch (presence or lack of error controls and synchronization);

(3) Automation of processing functions. The message processing functions automated within the terminal equipment, either through hardware/software/firmware or combinations thereof.

c. The current exchange of information between users of the AUTODIN is in the form of narrative text, card data, and magnetic tape data message traffic. Supporting these exchanges are the formats for entry and exit from the switched network including JANAP 128, JANAP 128 modified, and ACP 127. The following are the daily averages of AUTODIN message traffic sampled one day a month over a twenty month period (May 1976 to December 1977):

TABLE 7

DAILY AUTODIN TRAFFIC

Nature of Traffic	Message Entry	Message Exit*
Narrative	105,915 msgs	269,414 msgs
Card	83,461 msgs	77,615 msgs
Mag Tape	1,392 msgs	1,311 msgs

*Low exit figure explanation: Messages not recorded as delivered due to recording period, time of entry into system and length of message. In fact, messages are in system at ime of statistic recording, awaiting delivery to stations such as part-time centers.

2. Profile. Changes have been shown in the speed, mode and automation of terminals.

a. Shift to Higher Terminal Speeds. Since 1975, the net change in medium and high speed Mode I terminals is +55 with a corresponding decrease of -92 in the lower speed Mode I terminals. Therefore, there is a net decrease of 37 Mode I terminals over the past two years. However, there has been an increase of 3.4% in message volume and an 11% increase in lineblocks during this period.

b. Mode Shift. Increases in processing capability provided through the presence of programmable terminals has brought a reduction of the low speed Mode V terminals connected to AUTODIN. Since 1975, a total of 45 Mode V terminals have been eliminated. Also there has been an increase of 79 Mode II terminals, attributed primarily to the installation of query/response terminals for the Naval Investigative Service. There was no discernible intermode shift (i.e., Mode V to Mode I); rather, intramode (Mode I low to Mode I high) shifts were dominant.

c. Programmable versus nonprogrammable terminals. A total of 345 terminals (26% of the total 1322) possess some degree of software capability. Although management tends to concentrate on automated terminals and their inherent costs, the above statistic illustrates the point that the greater proportion of AUTODIN subscribers have little capability beyond traffic input and output processing.

d. Influencing Factors. There are several influencing factors that impact terminal operations.

(1) Remote Terminals. The advent of the AMPE serving multiple customers has brought a shift in the AUTODIN

architecture moving AUTODIN terminals as remotes to the AMPEs. To date, however, that impact has been negligible. By FY 1980, the number of remote terminals serving customers off the backside of AMPEs is projected to increase to at least 127. This projection is predicated upon the approval and subsequent installation of currently planned terminals to that date. The desirability of using remote terminals stems from the concept of operations, where large volumes of traffic can be automatically processed in an AMPE with remote subscribers using only inexpensive input/output devices.

(2) Terminal Leasing. Current practice among the Services/Agencies is the leasing of AUTODIN terminals. Since 1975, there has been a three percent increase, 41% to 44%, in the number of leased AUTODIN I terminals. These figures indicate an expanding interest in terminal lease arrangements. The monthly AUTODIN terminal lease cost is approximately (DELETED).

(3) Manpower reductions. The concern for achieving cost-effectiveness in terminal operations has guided the Services in their adopting terminal programs tailored to reduced manpower levels. The visible effects on this factor include interest in use of automation wherever feasible and cost-effective.

3. Programs. The variety of terminal equipments in use today require program support of significant degree considering training, maintenance, software support, and logistics. The existence of multiple terminal programs is due to differences in functional requirements and the existence of competitive equipment. Since not all terminals have equivalent capability, it has been necessary for the Services/Agencies to assume program responsibility for various terminal equipments to ensure the spectrum of communications requirements are satisfied cost-effectively. A corresponding overlap in the functional capability of competitive equipment is based on the competition for government dollars. Consequently, the Services/Agencies have been afforded the opportunity to be selective in terminal equipments, tailoring their terminal to precisely meet needs. The result is they have assumed program responsibility for terminals from different manufacturers, with similar capabilities to other Service/Agency terminals. The following is a listing of known active or pending programs developed by the Services/Agencies for terminal equipments provided by level of message processing requirements.

a. Level I-Teletypewriter (TTY) equipment. Requirements of the nature involving only narrative traffic at low speeds (asynchronous) are satisfied using TTY. Currently, there exist two main programs for TTY. Western Union

provides leased TTY equipment on a large scale. The Army has recently proposed a program to replace current TTY equipment using a Cathode Ray Tube (CRT) TTY. If adopted, this program would significantly increase the computer resources in the government inventory. Message preparation times can be significantly increase the computer resources in the government inventory. Message preparation times can be significantly reduced through use of the CRT equipment. Editing and correction functions, which in TTY applications require message proofs for editing and tape reruns for correction, can be accomplished much more swiftly using the CRT equipment. Currently, the Army is planning installation of approximately 1400 units during the period FY 79-82. The Navy expressed interest in also replacing outdated TTY equipment and voiced support for a DCA recommended joint Required Operational Capability (ROC) for this equipment. Air Force has undertaken a program to procure similar equipment. To date, there has been no action initiated to consolidate the requirements and procurement of this equipment. When the procurement is undertaken, it is recommended that the lease with purchase option acquisition be adopted. This procurement approach will allow the Services/Agencies the flexibility to apply state of the art advances as they accrue, with minimum investment loss, and to accommodate the common family of terminals application as it becomes available.

b. Level II-Digital Subscriber Terminal Equipment (DSTE). Requirements for card and narrative traffic (Mode I) are in part satisfied by the DSTE. There are approximately 375 DSTE terminals in the current inventory. However, the age of this manual terminal equipment led to the evaluation of the Standard Remote Terminal (SRT) replacement for the DSTE. Service/Agency inputs are included as Table 8. Both Army and Navy consider the SRT a suitable replacement for their DSTEs; however, NSA and DIA preferred use of other systems to the SRT. NSA maintained that Project RAILBED, designed to provide a more versatile STREAMLINER/ AUTODIN interface to replace the Common Control Unit (CCU) and Teletypewriter Adapter Module (TAM), and Project PULLBOAT, designed to provide TEMPEST approved Card Communications Terminals (CCT) at STREAMLINER sites, will satisfy DSTE replacement requirements. DIA specified replacing DSTEs with PDP-11/45 equipment to satisfy their requirements. The Air Force maintains the presence of the DSTE equipment returned to the inventory upon its replacement with the SRT by the Army and Navy will provide sufficient reserve, allowing continued support of the DSTEs they currently employ.

c. Level III-SRT. Requirements for terminals serving as input/output devices connected to large processing systems and having the capabilities of narrative, card, and magnetic tape are satisfied by the SRT program. The SRT is a TEMPEST cerfified terminal providing a modular approach to achieving various hardware

TABLE 8

DSTE REPLACEMENT PLANS

SERVICE	TIME FRAME OF ACTION	SYSTEM DESIGNATION	RATIONALE FOR SYSTEM
ARMY	FY 79-82	SRT	DSTE not economically supportable
NAVY	FY 79-83	SRT	DSTE not economically supportable
AIR FORCE	NONE	NONE	DSTE will continue to be supportable
NSA	FY 78-81	PULLBOAT RAILBED	Projects PULLBOAT and RAILBED will satisfy replacement requirements for non-supportable DSTE
DIA	FY 78	PDP 11/45	Technical upgrade
DLA		NO DSTE IN SERVICE	

configurations via a broad selection of peripheral devices. There are two key factors aside from mandatory requirements application that influence DoD use of the SRT: (1) system availability and (2) government obligation as set forth in the SRT contract. System availability has been established by the SRT contract (awarded on 22 August 1975), the initial equipment delivery order (given on 22 July 1977), and the Army-determined distribution schedule). The second influencing factor in the DoD use of the SRT is that the SRT contract specifies that the government shall purchase a minimum of 200 configurations with a projected cost to the government of approximately (DELETED). Employment of a system towards which significant resources have already been obligated should receive due consideration in determining Service/Agency use of the SRT. The following paragraphs will discuss the SRT capabilities and costs associated with contractual commitments and the engineering changes.

(1) Capabilities. The SRT has demonstrated, in the Army testbed model, the capability to transmit and receive data and narrative traffic using SRT to SRT via local switching, SRT to AMME to SRT with message processing accomplished in the AMME, and SRT to AUTODIN to SRT. Devices available in the SRT operation included Magnetic Tape, Optical Character Reader (OCR), Paper Tape Punch/Reader, Low/Medium/High Speed Printer, Card Reader/Punch, and Disk. Device to Device transfer between peripherals has also been demonstrated along with the capacity to provide JANAP 128 format message generation with editing, masks for easy message preparation, and error condition notification. Army SRT testing, leading to its conditional acceptance on 8 July 1977, indicated that further contractor development was necessary prior to placing the SRT in service. Cost influencing Engineering Change Proposals (ECP) related to human engineering factors have also been submitted by the Navy to ensure the SRT will be operationally acceptable. In addition, the Army has undertaken software/firmware enhancements to the SRT for expansion to a capability comparable with current automated terminals.

(2) Cost/Engineering Changes. During Fiscal Year 1979 final costs attributed to system changes will be available to the Services/Agencies. Impacting on these costs is an annual seven percent escalation factor applied to system costs. The effect of cost increases may reduce the competitive edge necessary for cost-effective SRT application. Further cost analysis, as figures become available, is in order to ensure the SRT is economically suitable for satisfying terminal requirements. Costs associated with the ECPs have not been included with the SRT cost.

(3) Summary. The use of the SRT is predicated upon matching the capabilities and cost-effectiveness of the system against communications requirements. The Services and Agencies were requested as part of an IASA working group effort to examine the SRT for possible use in view of the established capabilities, proposed modifications, and currently known system costs. As a result of the working group effort, it was determined that: (1) the SRT can satisfy a major segment of the communications terminal requirements of the Services/Agencies; (2) implementation of recently identified engineering change proposals will correct deficiencies noted in engineering and operational suitability evaluations; (3) an obstacle to immediate DoD application of the SRT is its availability; (4) application of the SRT is contingent upon its cost-effectiveness when compared with other terminal equipments. Costs of the SRT modification may serve as a mitigating factor against Services/ Agencies use of the SRT.

(4) Recommendations. The following recommendations are provided with respect to the disposition of the DoD use of the SRT:

(a) to continue the case-by-case waiver for use of comparable AUTODIN terminal equipment until the Standard Remote Terminal is available;

(b) that the Army, as the SRT Program Manager, pursue quantity-discount price negotiations with the SRT contractor;

(c) cost analysis of the SRT versus comparable terminal equipment should be undertaken by Services/ Agencies when final SRT cost figures are available.

d. Level IV-Automated Terminals. Requirements involving automation of processing functions for card, narrative, and magnetic tape traffic are satisfied by a multitude of programs. Several reasons for the many programs are:

(1) Degree of automation. There are requirements for various degrees of functional automation resulting from the need for efficient communications center operations.

(2) Software dependency. The procedural variations that exist among the Services/Agencies have resulted in the development of singularly applied software programs. Further, since automation of the functions is selectable, heavy reliance on the use of software has occurred.

(3) Standardization. The reliance on software to perform processing functions has restricted the standardization of the terminal systems to a large degree. Since software is machine dependent, the normal uniqueness of the software programs has prohibited the multi-service operation of terminals. The programs supporting the automation of message processing functions include the following:

(a) DCT-9000. All the Services have applied the DCT-9000 in varying configurations and quantities towards terminal requirements. After installation of the most recently identified requirement, the total DCT-9000 population will exceed 200 units. The flexibility of the system and recent price advantages to be realized through quantity purchase have made the DCT-9000 equipment cost-effective in medium volume message centers. Functions included in the capability of the DCT-9000 terminal include paper tape, card and magnetic tape processing.

(b) Others. There are six other identifiable terminal programs supporting the communications center terminal automation. These include programs for procurement and operation of IBM, Mohawk Data, CommTen, Burroughs, Control Data, and Honeywell systems, which total 88 equipments. AMPE programs are analyzed separately.

e. The Services/Agencies have undertaken programs to automate selective telecommunications center functions.

(1) Optical Character Recognition Equipment (OCRE). There are several on-going OCRE programs:

(a) JCS directed the Army to serve as program manager for the development and procurement of three OCRE configurations to satisfy all Services/Agencies requirements. These configurations are as follows:

1. Configuration A. Reader only, with plain language address (PLA) to routing indicator (RI) conversion and error correction to be accomplished by the terminal system.

2. Configuration B. Automatic format conversion of DD 173 messages to JANAP 128 with error correction and plain language address (PLA) to routing indicator (RI) conversion, accomplished through interactive video display unit (VDU) capability.

3. Configuration C. A fully automated message entry system providing format conversion from DD 173 to JANAP 128 and PLA to RI conversion with complete error correction and editing capability through an interactive VDU.

In the development process the Services provided the Army a listing of functional requirements and quantities desired from which a set of specifications were prepared by DCA. These specifications were forwarded to the Army for their use in OCRE development. The equipment specified has not been made available to the Services at this time. Impacting the development of the Army system was a decision by ASD (C^3I) that the SRT hardware be used to provide the three configurations of OCRE.

(b) The ASD (C^3I) directed the Air Force develop a stand alone OCRE similar to the C configuration and further requested the other Services/Agencies be queried as to their use for this system. The Navy and DLA expressed interest. The system used is the Lundy Farrington OCRE, already in the Air Force inventory.

(c) There are currently approximately 164 OCREs in use by the Services/Agencies. The reason for application of this system on such a widespread basis is the inherent cost savings that can be realized in the reduction of manpower through the automation of manpower intensive functions rather than complete message processing. Program considerations revealed the existence of five vendors actively supporting equipment requirements. Tailored application of the systems to satisfy requirements has been undertaken by the Services/Agencies.

(d) The following actions have been sponsored by the DCA in an effort to achieve standardization of development and application of OCRE.

1. A review has been undertaken of the original specifications for the three configurations and is expected to produce a set of standard OCRE specifications for all DoD use. Ancillary to the development of standard OCRE specifications, the DCA has also forwarded the MCEB a revised DD 173 format for DoD use in conjunction with the standard OCRE.

2. Development of a cost-effectiveness model for OCRE installation regardless of the configuration used. This model will be used by DCA in the evaluation of the Service/Agency automation plans when OCRE is involved.

3. The Army performed an analysis of OCRE acquisition alternatives. The result of the analysis was to provide a recommended procurement alternative based on comparison of all known programs for the three OCRE configurations. Army recommended that a competitive procurement be undertaken using the revised specifications, and in

the interim, the Services/Agencies acquire available equipment in satisfying requirements.

(2) Message Reproduction and Distribution.

(a) The Navy has pursued the development of a message reproduction and distribution system to satisfy automation of the manpower intensive functions associated with dissemination of message traffic. The program supporting the Navy requirements is the Message Routing and Distribution System (MRDIS). A total of fourteen systems have been identified for application.

(b) The JCS is implementing a large scale reproduction and distribution system, in conjunction with the consolidation of the Pentagon telecommunications centers, using Xerox's Automated Reproduction Collating System (ARCS).

(c) The Department of State ARCS program for automated message distribution has been evaluated by the Services. It was determined that the cost effectiveness of the ARCS would limit its application within the DoD unless applied to extremely large telecommunication centers. As technology advances, however, the cost effectiveness of automating message handling functions using a similar concept as the ARCS would permit its widespread application.

4. Implementation Alternatives. Three alternative approaches to providing terminal equipment are analyzed. The objective of this analysis is to aid in reducing the terminal program proliferation and aid in enhancing the opportunity to achieve maximum standardization with increased cost effectiveness.

a. Alternative 1. Continue Service/Agency independent terminal program developments until the common family of terminals is available. Current terminal program developments do not require inter-Service/Agency coordination. This course of action provides the Services/Agencies independence in defining equipment capabilities, particularly software. The equipment made available from independently managed programs is unique, in that it is tailored specifically to meet the managing DoD components requirements. Software independence permits the Services/Agencies to operate efficiently with procedural requirements achieved through software programming. With the availability of the common family of terminals, the Services/Agencies would be required to develop program support for implementation of this equipment.

(1) Advantages. The Services/Agencies can tailor equipment capabilities to closely match terminal

requirements promoting efficient communications center operations in view of current procedural practices. State-of-the-art advantages can be realized by the Services/Agencies through program development including these features.

(2) Disadvantages. This course of action will continue proliferation of terminal equipment within the DoD. By tailoring equipment for unique requirements, progress towards achieving standardization between the Services/Agencies would continue to be difficult and would contribute to excessive expenditure of funds.

b. Alternative 2. Withhold approval for all new terminal programs; permit current programs to continue until the common family of terminals is available. There are sufficient programs within the DoD to satisfy projected requirements for terminal equipment until such time as the common family of terminals is available. Therefore, no new programs should be needed. Unforeseen requirements would be satisfied using available terminal equipments. This approach reinforces the standardization of the terminal environment by requiring the Services/Agencies to use only equipment now available, which in some cases may force the user to adopt different Service/Agency procedures. Standardization of procedures is the key to an integrated AUTODIN system and is covered in detail under Special Items. The results of the standardization effort will be most effective when applied to a stable communications terminal program environment. With the availability of the common family of terminals, the Services/Agencies would be required to develop program support for implementation of this capability.

(1) Advantages. By requiring the Services/Agencies to use available equipment, the move towards a standardized DoD communications system would be greatly enhanced. The absence of new programs would reduce terminal program proliferation, and would aid the DoD movement towards interoperability within the DCS.

(2) Disadvantages. Unforeseen new terminal requirements would be dependent upon current technology and available equipments. Therefore, the Services/Agencies would no longer have the flexibility to tailor new equipment to specific needs. Also, the Services/Agencies would not be able to apply state-of-the-art advances in terminal equipment, depriving them of the advantages therein.

c. Alternative 3. New terminal program approval subject to OSD/JCS review/coordination/concurrence; continue current terminal programs until the common family of terminals is available. The need for additional programs contingent upon critical unforeseen operational requirements that cannot be cost effectively satisfied by current programs may require the Services/Agencies to develop new terminal programs. The use of OSD/JCS involvement is twofold. OSD can serve as the focal point for DoD application of equipment developed from an additional program, ensuring interoperability considerations are implanted in the program, and, in the event a program exists unknown to the requiring DoD component, reduce the probability of terminal program proliferation. JCS involvement ensures all DoD component participation in the development process. Allowing current programs to continue until expiration serves the same purpose towards standardization as listed in Alternative 2. Upon development of the functional specification for the common family of terminals in August 1979 and its implementation in 1983, the terminal environment will be stable.

(1) Advantages. DoD coordination in the development of new programs effectively reduces independent program development and insures wider application of available equipments. When new requirements arise which cannot be satisfied by available equipment, they would be developed as a DoD program rather than the individual Service/Agency programs. An example of this in action would be the development of the TTY requirement outlined in a recent Army ROC. All three Services have expressed interest in the development and procurement of new TTY equipment, however, independent procurement paths are being pursued. An OSD/JCS role would ensure there would be one standardized system based upon functional specifications rather than separate programs.

(2) Disadvantages. The Services/Agencies would no longer have the flexibility to pursue tailored equipment to meet terminal requirements.

d. Conclusions.

(1) Alternative 1 offers little potential for promoting standardization and halting proliferation of terminal equipment. The advantage of tailoring terminal equipment to satisfy Service/Agency requirements needs to be balanced against the costs associated with maintaining separate programs and the impact on DoD terminal standardization.

(2) Alternative 2 provides the foundation for moving the IAS architecture towards standardization, but limits the Services/Agencies flexibility in satisfying unforeseen, justifiable requirements.

(3) Alternative 3 provides for OSD/JCS concurrence on any new Service/Agency terminal programs until the functional specifications for a common family of terminals is available in August 1979. This alternative provides the means to satisfy new requirements in an orderly manner, with a reduction in the risk of terminal proliferation and program duplication. It also provides, in the near term, a solid foundation for the standardization of terminal procedures and equipments.

e. Recommendation. Alternative 3 be selected as the implementation alternative for terminals.

E. Special Items.

1. Standards. Within the IASA, standards take many forms. They deal with the sophisticated protocols, interfaces, modes of operation, formats, controls, management, equipment designs and capabilities, as well as the micro-functions of what information is required for record keeping to determine proper handling of a message. Standards are required to provide uniform guidance for the design, development and implementation of any evolving future system. Providing these standards for guidance from the concept engineering stage to the implementation stage will help to reduce design inefficiencies and reduce overall costs as well as prevent interoperability problems during or after implementation. Further, standards establish a reference source of design guidance that will: (1) minimize unilateral design decisions by one project engineering group; (2) pinpoint areas where design decisions are needed; (3) facilitate the comparison and evaluation of design criteria in regard to trade-offs and impact on other subsystems and overall system performance; and (4) provide wider exposure of design decisions to all interested activities. As a result a standard for Long Haul Communications Switching Planning Standards for the Defense Communications System, Military Standard 187-310, has been developed. It covers such issues as subsystem interfaces, computer software, precedence handling, speed of service, minimize, formats, link protocols, and mode protocols. The following is a discussion of unresolved issues:

a. Message Forms. A study was made of the present DD Form 173 (OCR), JOINT MESSAGEFORM, and discovered that there are three such forms in existence. Each Military Department has in some manner made small deviations from the basic standard provided in MIL-STD-188C. It was also discovered that each Military Department was programming their OCR equipment to conform to either Military Department or local requirements in the preparation and reading of the "standard" form. It was further noted that the printing of the form in an unauthorized drop-out color was being accomplished. To provide a standard for the Department of Defense use the

three forms were compared and a revised form was developed. The form was updated to include additional information to include new requirements of the system such as the using of a Special Category designator to ensure U.S. traffic would not be inadvertently sent over an allied line. At the same time revised instructions for the completion of the form were prepared. The recommended revised form and preparation instructions were provided the DCA representative of the Methods and Procedures Panel of the MCEB for that board's approval, implementation, and inclusion in the appropriate Military Standard. Unless strong resistance to standardization is met in the MCEB arena, no further action on this item is contemplated under the IASA project.

b. Addressing and Routing Traffic Procedures. For years each Military Department has had their own standard plain language address for their subordinate organizations and had these published in their service publication. On 9 June 1975, the MCEB issued a directive to establish a Standardized Plain Language Address System. In an attempt to standardize Plain Language Addresses (PLAs) a first effort was made to standardize abbreviations, geographic locations, etc. Due to Service/Agency parochialism this obstacle could not be overcome. Rather than standardize elements of the PLA it was agreed that the term "standard PLA" would be construed to mean "a single way of addressing a particular command or activity as determined by the responsible service or DoD agency." Because of the magnitude and impact of this action item, it was briefed at the Principals' meeting in May 1975 for resolution of the problem. A two step approach was established. Step one was for DCA to prepare and distribute a DoD PLAD and the Services would continue to use their PLA documents. The DoD PLAD would be distributed to Service elements for review and comments as to its feasibility. If the DoD PLAD concept is acceptable, the second step would be taken to publish a single DoD PLAD. DCA, in concert with the MCEB prepared a DoD PLAD consisting of DoD agencies and commands, as well as other Federal Government agencies that fall under the auspices of the National Communications System and use DoD communications facilities. The final decision of the MCEB was to prepare the document as a MCEB document rather than a DCA publication. The document was completed, distributed, and the effective date of 1 July 1977 was promulgated. A six month review period was established as part of the Principals' guidance. The Department of Air Force requested a three month extension of the evaluation period due to some

internal distribution problems. This will extend the final action of step one by the MCEB to approximately June 1978. Routing of traffic within AUTODIN I will continue to be by Routing Indicator as prescribed by ACP 117 and supplements thereto. AUTODIN II will use a logical address located in the packet header as supplied by the bit-oriented subscriber or by the interface device for character oriented subscribers

c. Automated Distribution System/Methods. On 27 May 1973, the MCEB issued a directive for the development of a standard message delivery system. To get an unbiased look at the problem, a study contract was awarded KETRON, Inc., on 15 July 1975. This study was provided the MCEB on 11 December 1975. The MCEB reviewed the study and presented a briefing to the Principals on 29 June 1976 with recommendations that the study be forwarded to the JCS for review by the administrative people as they would become involved with whatever system is implemented. The JCS requested the Services, DCA, DIA, and NSA review the Ketron study and provide their comments. On 12 April 1977, JCS opened a joint action on this subject. The JCS action was completed in December 1977. Its recommendation to the MCEB is that a standardized content code applied by the message writer is not supported by the JCS, however, scanning techniques which permit the use of plain language cues such as flagwords, functional address and office codes, keyphrases, reference and report types could be supported but would have to be tailored to meet variable requirements of telecommunication centers.

d. Privacy Considerations. In AUTODIN I, the AUTODIN Limited Privacy System (ALPS) provides the level of privacy required by not recording traffic on history tapes within the ASC. In addition to message security protection provided by security markings of the message, a Transmission Control Code (TCC) is included in AUTODIN II to identify a community-of-interest. Each TCC is a unique and separate code that does not have dependency on another TCC or security classification code or designator. To enter a specific network or terminal, verification of the TCC is made by the system prior to transmission of the data to the terminal. In addition codes may be included in the Host Level Protocol. To ensure privacy and security is maintained, both the originating and receiving terminals must be classmarked in the PSN software for entry and receipt of the TCC being used.

e. Telecommunications Center Manning Standards. With the implementation of telecommunications center automation, the Services/Agencies have pursued the development of manning standards. The following identifies progress by the various DoD components towards adopting manning standards for automated telecommunications centers:

(1) Army. The Army has completed a preliminary staffing study and data gathering. A staffing standard is undergoing development and should be available in the near future (April-May 1978).

(2) Navy. The Navy has completed data gathering and is expecting to complete a draft standard in April 1978. A scheduled sixty (60) day review period, during which the Navy expects to provide opportunity for command review, will immediately follow rough draft preparation. Navy-wide implementation of the standard is expected as of 1 October 1978.

(3) Air Force. Air Force has completed preparation of an automated communications center staffing document and is awaiting Service staffing prior to implementation.

(4) NSA. As of 26 September 1977, NSA has instituted a communications staffing standard for all their telecommunications centers.

(5) DIA. DIA is using the NSA developed standard.

(6) DLA. DLA manning of automated telecommunication centers is position-oriented due to the unique nature of traffic transmitted and received. Consequently, a de facto standard exists for their communications centers. Adoption of a DoD standard pertaining to narrative traffic would not affect their communications center operations.

The DCA has formed a working group to address the development of a DoD standard manning document for telecommunications center manning.

2. <u>DSSCS/GENSER Telecommunications Center Consolidation and Extension of Automation.</u>

a. Prior to 1973, DSSCS and GENSER record traffic was processed within physically distinct communications networks. In July 1972, an AUTODIN I system enhancement was provided which permitted use of the AUTODIN I to handle both DSSCS and

GENSER traffic. Both DSSCS and GENSER were maintained in a segregated environment, with terminals designated as either DSSCS or GENSER, but not both. Thus, AUTODIN I was operated as if it consisted of two virtual networks, each of which operated in a system high security mode, without mutual interface. Thus, separate DSSCS and GENSER terminal facilities are installed at most major military installations.

b. In 1976, AUTODIN I was enhanced to permit a single connected terminal to transmit and receive both DSSCS and GENSER record traffic. The connected terminal is required to operate in a DSSCS accredited environment. This enhancement allows physical consolidation of DSSCS and GENSER terminal facilities at a geographic location. Such physical consolidation offers the potential for cost and manpower savings. In recognition of this potential, the DoD telecommunications community has identified 139 locations which exhibit sufficient potential as to warrant a consolidation feasibility study. Feasibility study completion dates from February 1978 through September 1978 have been established by JCS. Thus, a program to provide intra-Service physical consolidation of DSSCS/GENSER facilities within a local geographic area is well underway. The IASA will accordingly be required to accommodate a smaller number of terminal connections. AMPE facilities now being fielded provide extension of automated services to connected remote terminals. Currently, only the NSA AMPE, the STREAMLINER, has been accredited to process DSSCS traffic; the STREAMLINER, as well as connected remote terminals, may process DSSCS traffic. A connected remote terminal may operate as a DSSCS or a DSSCS/GENSER terminal; it may not, however, operate as a GENSER-only remote terminal. The Army and Navy are pursuing DSSCS accreditation for their AMPE facilities, while the Air Force is considering so doing. An accredited automated terminal must conform to the stringent criteria jointly developed by NSA and DIA, and shortly to be released as a DoD Manual. Accreditation of AMPE facilities permitting connected DSSCS remote terminals will result in reduced direct terminal connectivity to the IASA backbone. Establishing accreditation in a system high mode of operation, i.e., all connected remote terminals conforming to DSSCS criteria, is a much less severe problem than that posed by connection of a GENSER-only remote terminal. Software routines and hardware modifications permitted the AUTODIN I system to handle both DSSCS and GENSER traffic, while maintaining proper traffic segregation. Terminal users connected to the AUTODIN system are unable to access AUTODIN system software. Some users are connected to AMPEs via inquiry response terminal devices which, in the absence of proper safeguards, could be used to assault the system.

c. The previously mentioned DoD Manual will provide guidelines which must be met for accreditation of an AMPE with connected DSSCS and GENSER-only remote terminals. NSA is conducting an internal study to determine the modifications required to obtain such accreditation for the STREAMLINER. Both consolidation and extension of automation require a solution to the multi-level security problem. AUTODIN I solved the problem by operation in a system-high environment, and by hardware/software segregation in a relatively benign environment. The recent Report of the Ad Hoc Working Group for ATMHS Review concluded that, without resolution of the Multi-Level Security problem, parallel systems development and installation would continue. The Working Group recommended that NSA be tasked to evaluate near term alternatives to the Multi-Level Security objective. Such an evaluation would produce an acceptable interim standard solution.

d. Major R&D resources are currently committed to the relatively long-term BLACKER program, which will provide an end-to-end encryption solution to the network multi-level security objective.

3. <u>Baseline Allocation of Functions.</u>

a. General. As part of the IASA project design baseline data base gathering, seventy-four (74) telecommunications functions now performed within or considered candidates for performance within AUTODIN have been identified and defined. In addition, the functions have been tentatively allocated to the elements of a postulated 1980 architecture (Figure 4), consisting of terminals and nodal facilities, with an AUTODIN II backbone.

b. Allocation Scheme. Appendix 3, Part 1, provides the baseline allocation of telecommunication functions perceived to be required in the near term 1978-83 IAS. In addition, Part 2 of Appendix 3 provides a priority listing of the telecommunications functions which establishes the criteria for future decision making in view of potential economic constraints on the allocation of these functions. Underway is an AMPE Phase III cost/benefit analysis study, the results of which will aid in the cost analysis on the remaining telecommunications functions.

4. <u>ARPANET connectivity to AUTODIN II.</u>

a. General. The ARPANET came under the operational management of DCA on 1 July 1975. DTACCS approval of AUTODIN

II, Phase I indicated that the Military Department/Defense Agency ADP systems on the ARPANET should configure their design so as to minimize the impact of reconnecting to the AUTODIN II. The results of a recently completed survey of ARPANET subscribers are:

(1) The ARPANET is an operational, common user, data communications network, not an R&D network.

(2) The ARPANET is divided into servers and users. Server hosts are mostly government owned and are located at universities and corporations. Users are on the network primarily to access the server.

(3) The ARPANET community of interest is an interwoven conglomeration. The ARPANET provides capabilities for interaction between all its users, and in practice, the intercommunication between military and non military users is significant. The transition must provide for continuing intercommunication between the users.

(4) DARPA uses the ARPANET for backbone communications for some existing R&D efforts.

(5) The ARPANET can provide transmission security from host to host.

b. Implementing Alternatives.

(1) Alternative 1. Continue to operate the existing ARPANET.

(a) Advantage: Maintains the status quo.

(b) Disadvantages:

1. The ARPANET, a first generation packet switching network, has aging equipment and maintenance costs which will become prohibitive within another 3 years.

2. Ignores intent of OSD that AUTODIN II serve general DoD ADP systems as well as military operational systems.

(2) Alternative 2. DCA continue to operate the ARPANET for an additional 3 years. Identify and transition selected users to AUTODIN II.

(a) Advantages: Continue operational management and existing network as is.

(b) Disadvantages:

1. Availability of AUTODIN II protocols and interface control criteria. ARPANET hosts or nodes will have to access AUTODIN II using the Binary Segment Leader (Mode VI type) protocols. These protocols are due from the AUTODIN II contractor in August 1978. ARPANET nodes and/or hosts must develop their own Host Specific Interface.

2. Leaves unanswered the question of what to do with the users not transferring to AUTODIN II.

3. Requires an R&D effort to determine method of providing intercommunication. This effort would be of limited value upon demise of the ARPANET.

(3) Alternative 3. DCA contract with a Value-Added Carrier (VAC) to take over communications services provided by the ARPANET:

(a) Advantages:

1. Provides a continuing communications vehicle for users not transitioning to AUTODIN II.

2. VAC could develop the interface to AUTODIN II.

3. VAC would provide conversion to X25 interface (the international standard).

(b) Disadvantage: As cost competitiveness accrues from volume discounts, the government may be required to continue in a management capacity pertaining to the contract.

c. Analysis.

(1) Alternative 1 maintains the existing ARPANET and ignores the cost advantages of transitioning ARPANET users to the AUTODIN II.

(2) Alternative 2 continues the ARPANET for a period of time while transitioning some subscribers to AUTODIN II. Information presently available indicates that ARPANET DoD subscribers have a continuing communications requirement with non-DoD and non-government ARPANET subscribers. This requires some method of providing a continuing communications capability for any existing ARPANET subscriber transferred to AUTODIN II with hosts left on the residual ARPANET. The most feasible way to provide this capability is via a gateway. The gateway concept will push the state-of-the-art, and will also cause security certification concern.

(3) Alternative 3 assumes contracting the communications functions for the ARPANET to a VAC. There is some indication that a VAC would bid a three year contract to provide the ARPANET communications at a lesser cost than presently being experienced. Included could be design and implementation of a gateway between the VAC and AUTODIN II and access to the international carriers by conversion to the X25 interface. A BTL could accrue for the three year period and reduce to zero at the end of the three year period.

(4) Approach. ARPANET connectivity to AUTODIN II will begin in late 1980 and be completed in 1982. All desiring ARPANET users who can satisfy the criteria of JCS MOP 165 will be transferred to AUTODIN II. Government packet switching R&D users, which comprise a small percentage of the net, will be provided service through other government sponsored programs. The larger percentage of current ARPANET users will be transferred to a Value Added Network (VAN) and a gateway of the VAN to AUTODIN II, if required, will be provided.

5. WIN Integration into AUTODIN II

a. General. Memorandum by ASD/CCCI, 7 October 1977, subject: "Prototype WWMCCS Intercomputer Network (PWIN)," directed that a plan for the implementation of WWMCCS internetting be developed. The JCS is preparing a WIN Implementation Plan that provides, in part, the transition of the WIN to AUTODIN II.

b. Network Evaluation. In accordance with the draft WIN Implementation Plan, the PWIN will be redesignated as the WIN on 1 April 1978. The 1977 PWIN of 6 IMPS and 6 Hosts will evolve into the 1980 WIN of 10 IMPS and 21 Hosts. The transfer of WIN sites to AUTODIN II subscribers will begin in mid-1980 when the prototype WWMCCS ADP Network Front End (WNFE) is first available, and will be completed in 1983 when the fully capable Network Front End (NFE) is available. Refer to Table 9. The WIN Implementation Plan, in part, will provide the goals and objectives of the network and will propose a three phase approach which identifies management requirements, network configurations, milestone schedule, resource (manpower/funding) requirements, and transition to AUTODIN II. The plan conceives the implementation to be spread over three phases. It will transform the existing prototype network into an operational system. The first phase is designed to be a period in which the network gradual transitions and expands from a prototype network to an operational capability. During the first phase, the number of network subscribers will be expanded; procedures and policies for network operation refined; studies and analyses to expand and enhance network applications and information exchange conducted; new network management and coordination agencies activated. In Phase II the network will provide full support to the WWMCCS. WIN Phase II will begin with the cutover to WWMCCS System Release 7.1, projected for January 1979, and will end with the cutover to the AUTODIN II. During Phase II the communications related capabilities of the network will remain essentially stable, but the user applications reporting systems and procedures will continue to be improved. Technical plans for interfacing the WWMCCS computers into AUTODIN II and managerial plans for the conversions to AUTODIN II support will be completed during this phase. WIN Phase III begins with the cutover of the WWMCCS computers to AUTODIN II communications support. Expansion and improvement of network oriented user applications and reporting systems, and procedures will also be accomplished during this period.

c. Transition Issues. During the initial two phases the host computers will be interconnected by a dedicated communications subnet employing the WWMCCS adaption of a packet switching technology based on the PWIN program. During Phase III the communications support will be provided by AUTODIN II. For the period prior to AUTODIN II support, the WIN will be configured to support those WWMCCS commands which have responsibilities in time sensitive crisis situations. The WIN will be transferred to AUTODIN II support when it is established that AUTODIN II is capable of providing the interactive capabilities needed by the WWMCCS.

plan identifies the AUTODIN II conversion plans to be developed and assigns responsibility for their development. During Phase III the WIN will receive packet switching support from the AUTODIN II common user system. The interconnection of the WWMCCS computers to the AUTODIN II will require special hardware and software in order to achieve a full interactive capability. Each host will function as network front end. The WWMCCS network front end will be connected to the AUTODIN II packet switch nodes via at least one data circuit.

TABLE 9

PWIN/WIN/AUTODIN II TRANSITION

	PHASE I (PWIN)		PHASE II (WIN)		PHASE III (AUTODIN II)
	1977	1978	1979	1980/81	1982/83
IMPS	6	9	10	10	
Hosts	6	12	19	21	
Concentrators	-	1	1	1	
Terminals	11	13	12	11	
DIN II Subscribers					25

6. Tactical Forces. Interface of tactical forces to the DCS will be via the TRI-TAC AN/TYC-39 Store-and-Forward (S&F) Module. The AN/TYC-39 was initially envisioned as serving both a tactical and a strategic function. In its tactical role, it would interface with AUTODIN as a Mode I terminal. In its strategic role, it would serve as an ASC. Advancements in technology, AUTODIN software enhancements not incorporated into TYC-39 software, increased costs, and changes in the hardware capability of the TYC-39 combined to eliminate the TYC-39 as a viable candidate for direct

ASC replacement. The tactical role of the AN/TYC-39 remains valid. Deployment of the AN/TYC-39 as a message switch in the forward area, will provide primary DCS interoperability for tactical forces.

7. Automated Text Message Handling Systems (ATMHS).

a. General. On 25 March 1977, the Surveys and Investigations (S&I) Staff of the House Appropriations Committee (HAC) published a report highly critical of DoD management citing lack of standardization and duplication of effort in ATMH Systems development. An Ad Hoc Working Group for ATMH Systems review, chaired by DCA and composed of representatives from the Services and Defense Agencies, was formed on 18 November 1977 and completed its report on 13 December 1977. The report will be forwarded by the JCS to ASD/CCCI. The report categorizes ATMH Systems as telecommunications oriented (concerned with message transmission and distribution) and information oriented (concerned with message content). The report evaluated 10 telecommunications oriented and 12 information oriented ATMHS.

b. Analysis. The ATMHS report concludes that functional standardization and operational validation of telecommunications oriented ATMH Systems are being adequately addressed within the IASA project, but that functional standardization and operational validation of information oriented ATMH Systems are not being comprehensively addressed. Therefore, the report recommends DCA as Project Manager to establish an IASA-like program to provide functional standardization and operational validation for information oriented ATMHS.

8. Billing Structure.

a. DCA, assisted by the Institute for Defense Analysis (IDA), has examined various rate structure alternatives for the AUTODIN I and AUTODIN II. Current plans call for continuation of the present rate structure for AUTODIN I through FY 1979. This structure is based solely on connectivity and speed of service. Beginning in FY 1980, plans are to implement a revised billing structure for AUTODIN I based on connectivity and use. ASD(C) approval of the revised structure will be requested as part of the FY 1980 CSIF Budget Submission.

b. The following schedule of events apply to the AUTODIN II rate structure:

(1) Prior to the AUTODIN II Phase I FOC during FY 1980, the current weighted unit billing structure, based on the speed of service, will be used.

(2) During FY 1980, sufficient traffic and use experience data should be available for FY 1981 implementation of a connectivity/use billing structure. ASD(C) approval will be requested during the CSIF FY 1981 Budget Submission during the September 1979 time period.

(3) Based on study results, present estimates are that approximately twenty percent of the backbone cost will be based on connectivity and eighty percent based on use (number of packets transmitted).

(4) The subscriber rate for AUTODIN II will be developed based on the concept that the majority of revenue collected by the CSIF should be based on network use and that rates should encourage the precedence qualified users to eliminate unnecessary precedence traffic. The rationale for emphasizing use is primarily to enhance cost discipline of requirements and to match system capability to user requirements. A fundamental principle applied during design of this system was to develop a network that could be sized to fit the user requirements. (This design principle has been achieved but its effectiveness depends in part, on a rate structure that will influence usage, hence the size of the network.) Use not only applies to how much traffic (packets) is generated, but also the precedence, distance and geographical locations of the traffic. Since all will affect the network size, they will be considered during the rate development process. Traffic volume, however, will be the major factor used in determining the size of the switches and the number of trunks required.

9. Security.

a. General. Recent trends in teleprocessing technology are producing changes in the user security environment. More and more, teleprocessing capability is being extended to lower levels of communications and will eventually evolve to the level of individual action officers (i.e., collocated with action office). Thus, not only will interactive ADP-type communications capabilities become proliferated, but the equipments to be used

will be in office environments incapable of providing the physical protection traditionally afforded COMSEC equipments. Numerous system interconnections with many communities of users will increase the need for access control mechanisms to restrict authorized use of files, programs, and other ADP resources, whether accidental or malicious.

b. Architectural Considerations. The following security techniques will be considered in the architectural development:

(1) Prepositioned user access criteria and traffic acceptance criteria within the network switches integrated with the automatic routing routines in order to provide security constraints on traffic flow.

(2) Validating subscriber access and notifying traffic recipient of the sender's identification (terminal authentication).

(3) Providing distinct separation of communities of interest within the common user network. This would protect against unauthorized access, provide a form of authentication, and protect against communications systems mistakes.

(4) Employment of certifiable and validated security controllers as a part of the ADP communications processor as a means to control unclassified subscriber access to the multilevel network, establish and validate user security credentials and communicate same to destination ADP system.

(5) Employment of automatic remote cryptographic keying and key distribution centers in conjunction with network procedures for isolation of communities of interest, authentication, etc.

(6) Employment of traffic flow security on all sensitive DoD communication circuits.

(7) Employment of off-line encryption by a user community to preencrypt traffic destined for common user bases where security segregation and/or privacy must be maintained. Data stored in the common data base would remain in the encrypted form. Of course, certain labels on the files would have to remain in plain-text to facilitate automatic file search.

(8) Employment of personnel security badges that would provide authentication of personnel assigned to a multilevel security access terminal.

(9) Employment of security kernel technology to facilitate formal verification of software development.

(10) The long-range IASA security architecture objective is to meet the multilevel-security issue via end-to-end encrypted data communications. A supporting RDT&E program will apply the encryption devices being developed in the NSA Blacker prototype end-to-end encryption program, the protocols and communications trade-offs being developed in the ARPA end-to-end encryption experiment, and the DCA (CCTC) secure network front-end development. Products of this effort will include the system concepts, key generator hardware and the controlling software for the encryption of packet switched data. The Blacker program, using selected test beds, will yield production key generators in the 1983 time frame.

SECTION IV

SECTION IV

TRANSITION STRATEGY

A. Achieving Evolutionary Transition.

1. General. ASD(C3I) quidance to the Defense Communications Agency (DCA) has been to achieve the IAS in an evolutionary manner; i.e., by a deliberate, continuous change from today's communications to the more sophisticated communications of the future. Several technology advances have been noted which will have impact on this changing environment. Communications systems are evolving in such a way that centralized management and automated control with minimal human intervention are becoming cost-effective. In addition, the IAS is not a single monolithic system which will "cutover" at a specified "IOC date". Instead it will grow incrementally into a complex, but unified, DCS subsystem during the period 1978 to circa 1990, with multiple IOC dates during that period for the various IAS elements with concurrent phase-out of obsolete elements. The planning of a smooth transition over that time interval is one of the most important aspects of the architectural strategy. The following time periods have been assigned to the various parts of the IASA project:

a. Near Term: 1978-1983.

(1) Deployment of AUTODIN II packet switches in CONUS and to a limited extent overseas.

(2) Thinning of AUTODIN I switch population.

(3) Complete deployment of the current generation of AMPEs by 1982 with further access area needs provided by an Inter-Service/Agency AMPE, which can serve all DoD users in an area and interface either AUTODIN I or AUTODIN II switches.

(4) Deployment of a common family of AUTODIN terminals based upon functional specifications.

b. Mid term: 1984-1988.

(1) Further deployment of AUTODIN II switches overseas.

(2) Phase-out of AUTODIN I switches.

(3) Provision for AUTODIN I unique functions in either an augmented Interservice/Agency AMPE or a Centralized Service Facility associated with AUTODIN II nodes or both.

c. Far term: 1989-Future. A third generation data system to be defined in conjunction with the other third generation subsystems of the DCS.

Viewed in this way the near term IAS can be looked at as an early DCS II capability which attempts to solve the terminal proliferation problem. The mid term system becomes a DCS II subsystem and the far term system a DCS III subsystem.

2. Architectural Development Works. The near term 1978-1983, IAS architecture has been described in Section III, however, the mid and far term IAS architecture has not yet been developed or selected. DCA has started the development of this architecture and two IAS architectures are postulated and evaluated for implementation. The description of these two architectures, the identification of required major network hardware elements and the identification of near term transitional commonalities are presented.

a. Terrestrial Switched Architecture. This architecture is basically an extension of the near term architecture and its functional elements are present in the circa 1990 architecture, although some elements have changed physically. The technological risk associated with this architecture is minimal because of its heavy reliance on the proven designs employed in the 1980 architecture. The terrestrial switched architecture, depicted in Figure 8, has been divided into the following levels:

(1) Backbone. The backbone will have highly interconnected PSNs centrally managed by a Network Control

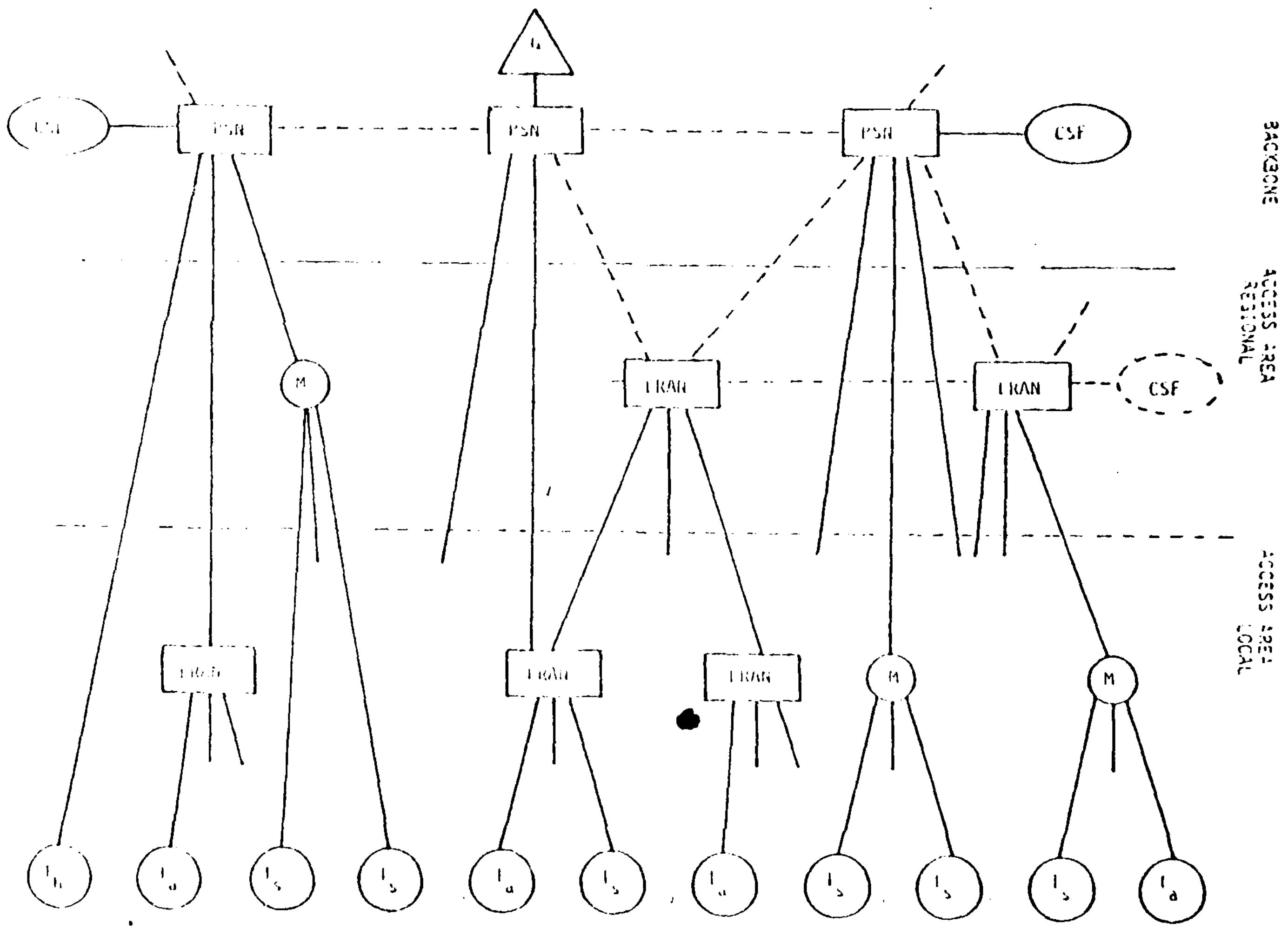


Figure 8. 1990 Terrestrial Switched Architecture

Legend

G - Gateway

CSF - Centralized Service Facility

PSN - Packet-Switch Node

M - Multiplexer

T - Terminal (Source/Destination of Traffic)

T_a - Specialized Subscriber

T_s - Slow Speed Subscriber

T_h - Host Computer

LRAN - Local/Regional Access Node

--- - Packet Backbone Trunks (up to T1 Carrier)

___ - Access Lines (150 bps to greater than 56 kbps)

Footnotes

1. The CSF while planned for the backbone could also be located in the regional access area.

2. It is anticipated that the LRAN will be implemented using standardized modules (both hardware and software) plus some special modules depending on site requirements. Also there may be significant differences between the local and regional LRANs in amount of processing power and the quantity and type of terminations.

Figure 8. Continued

Center (NCC) with centralized network problem solving by a Software and Hardware Test Facility for both CONUS and overseas. In addition to the PSNs, the backbone will have Centralized Service Facilities (CSFs) and Gateways.

(a) Definitions. The CSF is a new network element required to provide and enhance those services previously provided by the AUTODIN I. This new element is postulated to be a computer facility connected as a host computer to a PSN or to a regional node. The CSF would have considerable processing power combined with extensive memory in several media (e.g., core, fixed disc and dismountable disc). The CSF will provide certain message processing services (e.g., multiple and collective address handling, intercept and message retrieval) and any new teleprocessing services (e.g., electronic mail service, data teleconferencing and word processing). The gateway will provide the IAS with a means to interface other digital data networks such as special-purpose military and commercial Value Added Networks. This will provide for interoperability among data networks.

(b) Approach. The exact implementation has not yet been determined, however, architectural alternatives and recommendations will be provided in the January 1979 IASA report. A probable implementation would be as unique software modules in conjunction with standard hardware and software modules. (It is anticipated that a common family of functional modules will be used by terminals, access nodes and PSNs, as well as by the CSF and Gateway). The circa 1990 PSN, like the 1980 PSN, will be essentially identical to that of the AUTODIN II Phase I. As such it will be modular in both hardware and software such that individual nodes can expand and contract with changes in their terminations and traffic volume. The circa 1990 IAS will have end-to-end encryption capabilities. To support this capability, the backbone will also contain Key Distribution Center(s) (KDCs) to control end-to-end encryption and to distribute a variable to the cryptographic algorithm at the originating and terminating user terminals.

(2) Access Area (Local and Regional).

(a) Definition. The Local/Regional Access Node (LRAN) is postulated as an extension program to the Inter-Service/Agency AMPE, with a modularly-expandable multi-microprocessor architecture in the far term (DCS III) environment. The architecture of the far term IAS is expected to allocate certain functions to communications nodal facilities located at the local and regional access area levels. While the architectural description which will specify the functional performance requirements of these nodal facilities is not yet available, one can infer the expected nature of some, if not most of their functions by reference to today's ASCs and the AMPEs. These facilities will perform the broad range of nodal functions plus local message distribution functions and provide numerous services (such as plain language addressing) which, in a different architecture, might well be allocated to a different element. On the other hand, functions not performed by ASCs and Inter-Service/Agency AMPEs may also be allocated to the Local Regional Access Node (LRAN). It is anticipated that the regional version of the LRAN will have, in addition to its ASC/AMPE like functions, packet switching and packet interface capabilities. Thus, the terrestrial architecture trunking will be able to extend to the regional level, and for the satellite architecture, the LRAN, when combined with a ground station, will be able to handle the packet broadcast mode of operation.

(b) Approach. The regional access area will have packet LRANs and multiplexers. The LRAN will probably be connected to two PSNs and to other packet LRANs while the multiplexer will be connected to a single PSN or possibly a packet LRAN. The packet LRAN will have packet trunks to the PSNs and other packet LRANs. In the local access area there will be smaller LRANs serving geographical groups of subscribers. These local-level LRANs will be connected to either regional packets or PSNs. In addition to LRANs, local-level multiplexers will be used where transmission economies can be effected. While no lateral interconnection of local LRANs is anticipated, exceptions will be considered on a case-by-case basis. The local access area will contain a wide variety of terminals ranging from low-speed type terminals up through sophisticated host computer facilities.

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INTEGRATED AUTODIN SYSTEM ARCHITECTURE REPORT. PART 1.(U)

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(3) Development. Significant DCA and Service/ Agency Research and Development will be required for the functional specifications of a common family of hardware and software modules. It is envisioned that the common hardware modules would be procured to a specification which would stipulate their form, fit and function, but not the details of implementation. Included in the hardware complement would be processing, storage and I/O interface modules. In addition, effort will be required for the LRAN, CSF, Gateway and PSN to develop those unique hardware or software modules required for specific configurations. In order to enhance and complement the thrust to standardize computer software, a high order communications oriented language (COL) is needed. Also the conversion from total reliance on link-by-link to primary reliance on end-to-end security will require extensive, closely coordinated RDT&E effort. Reference is made to Table 10 for a summary of IAS RDT&E funds for the period FY 1977 - 1984.

b. Broadcast Satellite Architecture. Today, communications satellites are in general use for both DoD and commercial communications. Domestic commercial satellites, international communications satellites over the Atlantic, Pacific, and Indian Oceans and DSCS and NATO satellites are all being used as an alternative to cable, microwave, troposcatter, and HF for obtaining point-to-point connectivity. Commercial satellite services for the most part, are presently priced to compete with similar commercial services (cable), but eventually they are expected to be reduced in price. All of the above mentioned satellites operate in the same manner; namely, they provide a circuit between any two points. In each case the circuit is dedicated and acts as a replacement for a terrestrial link. The nature of the satellite is such that any signal beamed down is readable by any earth station equipped to receive the wideband transponder's signal and demultiplex it. This inate ability has the potential to be the driving force towards a new DCS architecture. In this broadcast satellite system, transponder capacity on the satellite is available to users via the regional packet LRANs. The regional LRANs will be equipped with a satellite ground station. These LRAN/ground stations will time their transmissions (which are wideband signals, up to the

TABLE 10

(TABLE DELETED)

IAS RDT&E FUNDS SUMMARY

capacity of the transponder) so as not to interfere with each other. Use of the "up channel" will be broken into time or frequency slots, each slot being used by a ground station to transmit the data the LRAN has accumulated from its input users. The techniques of managing ground station transmissions vary from simple contention methods to complex conflict-free multiple access protocols. It is envisioned that some technique will be employed such that the satellite resource will be adjusted by controlled allocation. Interconnection of the regional LRANs in this manner would effectively provide a fully connected network. Figure 9 depicts the broadcast satellite architecture which has been divided into the following levels:

(1) Backbone.
The backbone will consist of sufficient broadcast satellite transponder capacity to provide global coverage.

(2) Access Area (Local and Regional).
The regional access area will have packet LRANs and multiplexers. Each regional LRAN will have a satellite ground station associated with it. There will probably be some terrestrial interconnection between regional LRANs, dependent on geographical location and traffic volume. Some LRANs will have CSFs and/or Gateways associated with them. Some limited capability will exist in the regional packet LRAN to reconstitute a terrestrial switched network by calling up the necessary terrestrial communications media. The multiplexers and the local LRANs will be connected to the regional LRAN. In the local access area there will be smaller LRANs serving tight geographical groups of subscribers. In addition to LRANs, local-level multiplexer will be used where transmission economies can be effected. While no lateral interconnection of local LRANs is anticipated, exceptions will be considered on a case-by-case basis. The local access area will contain a wide variety of terminals ranging from low-speed terminals up through sophisticated host computer facilities.

(3) Development.
While significant effort will be required for the development of the common hardware and software modules for the unique modules for the LRAN, CSF and Gateway, and for the end-to-end security subsystem, these developments are identical to those described in 2a(3) above. On the other hand, development

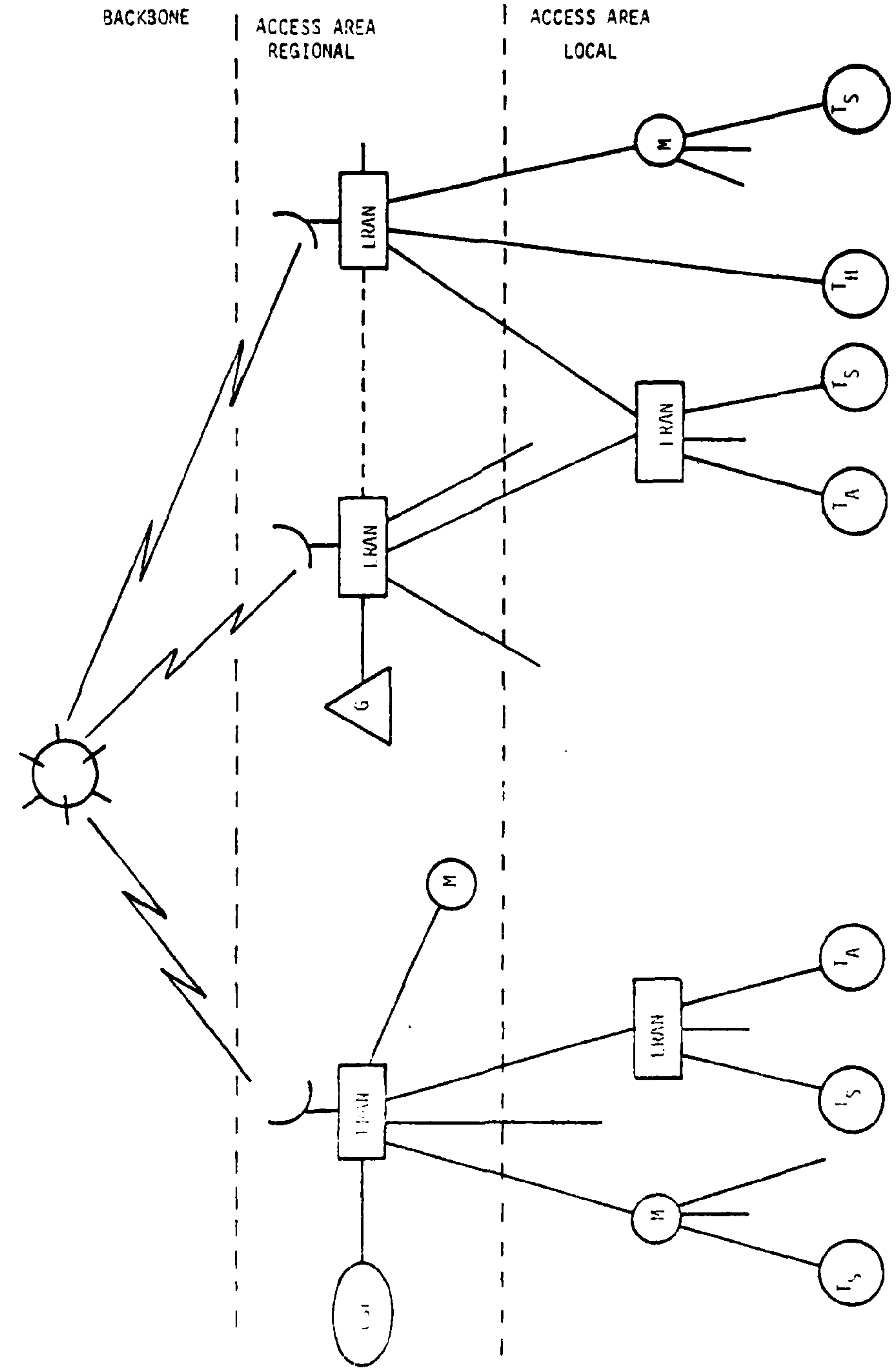


Figure 9. 1990 Broadcast Satellite Architecture

Legend

CSF	-	Centralized Service Facility
G	-	Gateway
M	-	Multiplexer
T	-	Terminal (Source/Destination of Traffic)
T_A	-	Specialized Subscriber
T_H	-	Slow Speed Subscriber
LRAN	-	Local/Regional Access Node
---	-	Packet Backbone Trunks
___	-	Access Lines

Footnotes

1. This CSF is the same CSF postulated for the Terrestrial Switched Architecture.

2. This gateway is the same gateway postulated for the Terrestrial Architecture.

3. Similarly the multiplexers and terminals are the same as those postulated for the Terrestrial Architecture.

4. Note the regional LRAN is depicted with an antenna to indicate that a satellite ground station is associated with the LRAN. Also note that some terrestrial packet trunks will probably exist, dependent on geography, traffic volume between pair of nodes, need for backup, etc.

5. The local LRAN is the same as that postulated for the Terrestrial Switched Architecture.

6. Both local and regional LRANs will be implemented using the common family of hardware and software modules and unique modules as required.

7. The significant difference between the two candidate architectures is in the backbone area, the satellite architecture provides only the transmission medium, the satellite. However, the satellite allows for full interconnection of the nodes which access it.

Figure 9. Continued

of satellite ground stations and the algorithm for accessing the satellite is a major requirement unique to the satellite architecture. Significant RDT&E effort to support this requirement has been planned under the Experimental Integrated Switched Network (EISN) project.

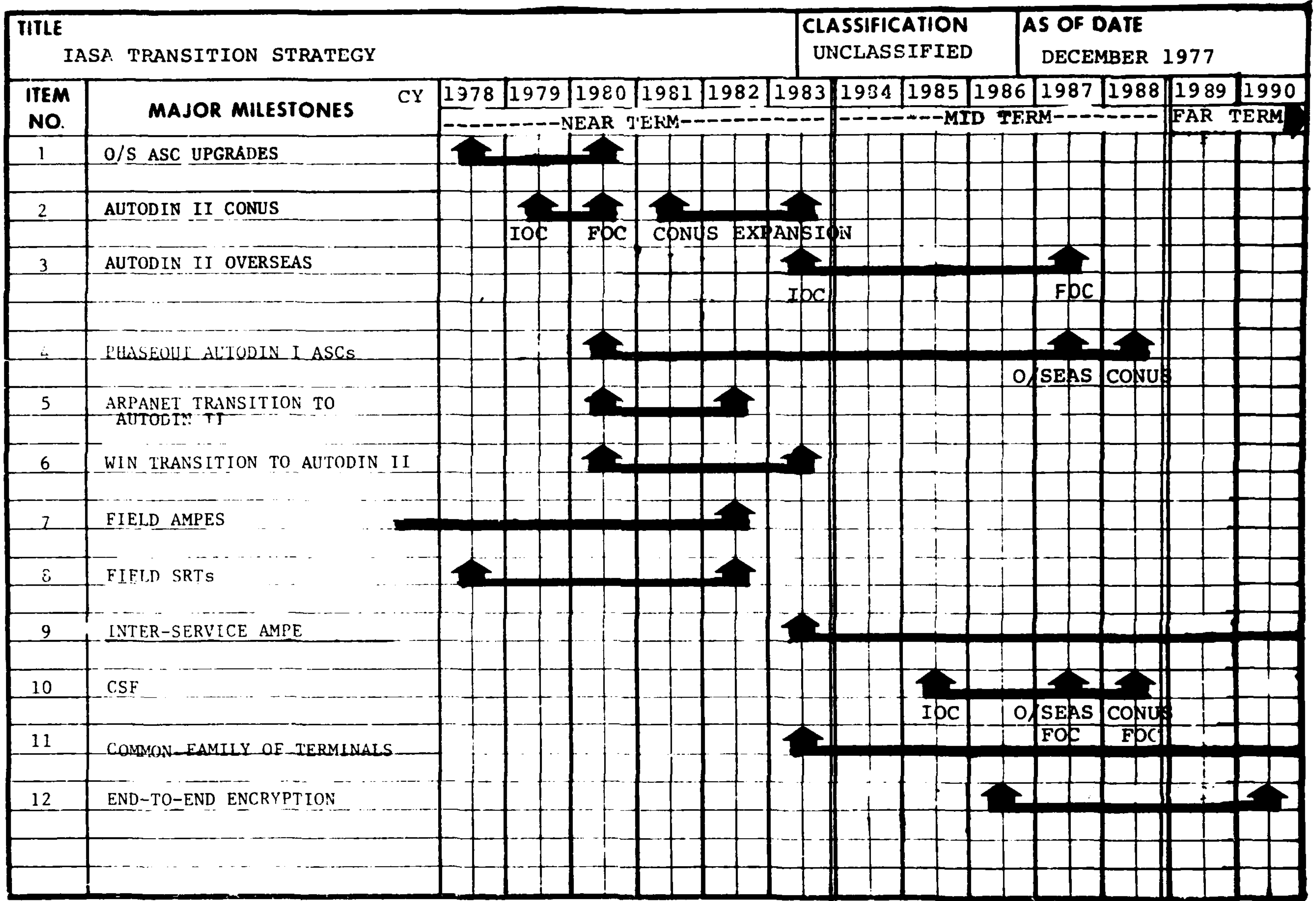
c. Outlook for the far term, circa 1990, IAS. It is reasonable to assume that the far term IAS will not be identical to either of the networks described in paragraphs 2a and 2b. The terrestrial switched architecture ignores the advancing state-of-the-art in satellite and communications technologies and the implications of distance, available media bandwidth and cost of O&M for backbone nodes and communications media. The satellite architecture ignores the available and in place CONUS media facilities and considerable investment in PSNs, inter-Service/Agency AMPEs, and other facilities. Further, neither architecture appears to take into account the vast difference in geography and political situations of the three locales of the global DCS - Europe, CONUS, and the Pacific. Other satellite access methods, using a terrestrial backup network to supplement and complement the satellite capability, are possible and the existence of a restoral capability for the DCS is a survivability requirement. Two types of LRANs are envisioned in these architectures. One is a regional version capable of operating as a packet switching node in direct communication with the packet broadcast satellite via the collocated satellite ground station. As such it provides backbone, regional, and local nodal functions, as well as ground station functions for the satellite. The second type of LRAN is a local version which would not have direct access to the satellite. This LRAN provides the functions required at the local level. It is connected to a packet LRAN to gain access to the backbone satellite. Both LRANs are implemented using the common family of hardware and software modules plus any unique modules required. The modular aspects of the LRAN should reduce maintenance costs and allow greater flexibility in sizing the stations, and would afford the potential of providing the capability of doing some of the CSF functions locally if required or desired by conditions. Note that the two architectures have numerous features in common; i.e., local and regional

LRANSs, local and regional multiplexers, CSFs, gateways and the same array of subscribers. Therefore, it is possible to proceed with confidence on an RDT&E program to develop the required modules. Moreover, the far term IAS could be a hybrid solution combining aspects of several possible solutions; further, it is possible that each of the three locales--Europe, CONUS, and the Pacific--will have different sub-architectures.

B. Analysis.

1. Approaches. The terrestrial and satellite candidate backbone architectures stated above, while differing widely in final approach, proceed initially from the near term 1978-1983 system architecture (presented in Section III) in the same manner. Further, in the access area, the similarities in the near term are more significant than the differences. Transition approaches, which do not proceed initially from the near term IASA, could have been postulated. However, such approaches would not be consistent with evolutionary transition and the efficient use of R&D resources. As the mid and far term architecture development of the IAS proceeds, the LRAN, CSF, and gateway concepts may be altered from what has been postulated.

2. Timeline. Figure 10 provides the IASA transition strategy for the period 1978 to 1990. The near term, 1978-1983, strategy shown in Figure 10 has been explained, by item, within Section III of this report. In addition, Tables 11 and 12 provide lists, respectively, of backbone and access area activities along with associated target dates in chronological order. Architectural development results for the mid term (1984-1988) and the far term (1989-future) IAS will be provided in the IASA Project Part 2 report, due January 1979.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1 O/S ASC UPGRADES
2 AUTODIN II CONUS
IOC
FOC
CONUS EXPANSION
3 AUTODIN II OVERSEAS
IOC
FOC
4 PHASEOUT AUTODIN I ASCs
O/SEAS
CONUS
5 ARPANET TRANSITION TO AUTODIN II
6 WIN TRANSITION TO AUTODIN II
7 FIELD AMPES
8 FIELD SRTs
9 INTER-SERVICE AMPE
10 CSF
IOC
O/SEAS FOC
CONUS FOC
11 COMMON FAMILY OF TERMINALS
12 END-TO-END ENCRYPTION
Figure 10

TABLE 11

AUTODIN BACKBONE MILESTONES

	ACTIVITY	CY TARGET DATE
a.	Overseas (O/S) ASC Memory Upgrade	1978
b.	CONUS ASC Tape Replacement by Disc	1978
c.	Phase Out one PAC Area ASC	1978
d.	IOC AUTODIN II Phase I	1979
e.	Start Phase Out CONUS ASCs Rehome Affected Subscribers	1980
f.	O/S ASC Tape, Card Reader and Printer Replacement; Upgrade of Patch and Test Facilities	1980
g.	Complete Fielding AUTODIN II Phase I (four PSNs)	1980
h.	O/S AUTODIN II Multiplexers	1980
i.	Start CONUS AUTODIN II Expansion	1981
j.	CSF Specifications and SOW Prepared	1982
k.	CSF Contract Award	1983
l.	Complete CONUS AUTODIN II Expansion (eight PSNs)	1983
m.	Complete Phase Out up to four CONUS ASCs	1983
n.	Start Fielding O/S PSNs	1983
o.	Start Fielding Gateways (as needed)	1983
p.	Start Fielding CSFs	1985
q.	Start Phase Out Remaining ASCs Rehome Affected Subscribers	1985

TABLE 11 (CONT)

	ACTIVITY	CY TARGET DATE
r.	Start Fielding End-to-End Security	1986
s.	Complete Fielding O/S PSNs	1987
t.	Complete Fielding Overseas CSFs	1987
u.	Complete Phase Out Overseas ASCs	1987
v.	Complete Phase Out DIN I ASC CONUS	1988
w.	Complete Fielding CONUS CSFs	1988
x.	Complete Fielding End-to-End Security	1990

TABLE 12

AUTODIN ACCESS AREA MILESTONES

	ACTIVITY	CY TARGET DATE
a.	Field AMPEs	In progress
b.	Start Fielding SRTs	1978
c.	Functional Specifications for Common Family of Terminals	1979
d.	Baseline Established	1980
e.	Inter-Service/Agency AMPE SOW/RFP	1980
f.	Inter-Service/Agency AMPE Contract	1981
g.	Complete Fielding AMPEs	1982
h.	Complete Fielding SRTs	1982
i.	Start Fielding Inter-Service/Agency AMPEs	1983
j.	Start Fielding New Generation Terminals	1983
k.	Start Fielding End-to-End Security	1986
l.	LRAN SOW/RFP	1988
m.	Field Evaluate Broadcast Satellite - Pacific	1989
	Europe	1990
	CONUS	1990
n.	Start Fielding LRANs	1990
o.	Start Voice/Data Integration Pilot Demonstration	1990
p.	Complete Fielding End-to-End Security	1990

SECTION V

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions.

1. The previous sections to this IASA project report have presented a picture of the AUTODIN system from the perspective of near term (1978-1983) implementation alternatives and mid/far term (1984-1990) architectural alternatives. Based upon user requirements and the need to provide more efficient common-user AUTODIN service, a transition strategy has been provided from today's AUTODIN capabilities to the circa 1990 Integrated AUTODIN System.

2. The overall objective of the IASA project is to design and engineer a system based upon AUTODIN I and AUTODIN II, which is complete and integrated from end to end. The IASA design is by necessity evolutionary in development, with the key ingredient being responsiveness to user needs. In meeting this objective, the IASA project has logically been divided into three parts. This report comprises Part 1 of the IASA effort and provides AUTODIN implementation alternatives through 1983. In January 1979, Part 2, architectural alternatives for the period 1984 to 1990 will be provided. In August 1979, Part 3, the functional specifications for a common family of terminals will be provided.

3. The AUTODIN terminal-to-terminal analysis has resulted in the following conclusions:

a. The current AUTODIN I store-and-forward system will continue to provide message service to the user community through at least 1985.

b. Implementation of eight CONUS AUTODIN II Packet Switching Nodes will make it feasible to close up to four CONUS AUTODIN I switching centers.

c. Analysis of Services/Agencies Automated Message Processing Exchanges (AMPEs) reveals that twenty-six of thirty-two evaluated telecommunications functions have a high degree of commonality.

d. An Inter-Service/Agency AMPE program is viable.

e. Some AUTODIN terminal hardware standardization exists among the Services/Agencies, but there is very little software standardization.

f. There are multiple AUTODIN terminal programs available to satisfy the Services/Agencies requirements until the common family of terminals functional specifications is available.

g. The Standard Remote Terminal (SRT) can be applied as a replacement for Digital Subscriber Terminal Equipment, as a remote terminal to an AMPE, and as a replacement for comparable automated terminals. On the other hand, the cost-effectiveness of the SRT as compared with other available terminal equipment will limit its application.

h. Physical consolidation of Special Intelligence and General Service Telecommunications Centers will provide significant equipment and manpower savings.

i. Telecommunications functions have been allocated to the elements of an IAS Architecture consisting of terminals and nodal facilities. As part of this functional allocation, a priority listing of seventy-four telecommunications functions has been developed which will aid in determining what system capabilities to provide under the AUTODIN architecture.

j. Security in the near term (1978-1983) time frame will be provided by link encryption. Solutions to the technical problems of providing AUTODIN end-to-end encryption will be dependent on such efforts as the NSA Blacker project.

k. ARPANET connectivity to AUTODIN II will start in 1980 and be completed during 1982.

l. WIN integration into AUTODIN II will start in 1980 and be completed during 1983.

m. A proposed Standard DD Form 173 Joint Message-form with a proposed method of completing the form has been developed and forwarded to the Military Communications Electronics Board.

n. A Joint DoD Plain Language Address Directory (PLAD) has been published, and is under evaluation by the Services/Agencies to determine its effectiveness as the single PLAD for the entire DoD.

B. Recommendations.

1. As a result of efforts to identify, correlate, and project the Services/Agencies AUTODIN requirements the following recommendations are that:

a. An Inter-Service/Agency AMPE program replace the current AMPE programs by 1983.

b. Services/Agencies continue their current terminal programs with new terminal programs subject to OSD/JCS concurrence and until such time as the common family of terminals is available.

c. Services/Agencies be active participants in the evaluation of selected telecommunications functions for AMPE standardization.

d. Services/Agencies conduct a cost analysis of the Standard Remote Terminal (SRT) versus comparable terminal equipment, to determine SRT cost-effectiveness.

e. A standard message delivery system be developed for AUTODIN terminals in order to assist in developing the functional specifications for a common family of terminals.

f. A uniform staffing standard for automated and semi-automated telecommunications centers (TCCs) be established.

g. A revised CSIF billing structure based upon connectivity and use start in fiscal year 1980 for AUTODIN I and fiscal year 1981 for AUTODIN II.

APPENDIX 1

ACRONYMS

APPENDIX 1

ACRONYMS

ADCCP	- Advanced Data Communications Control Procedures
ADU	- Accumulation Distribution Unit
ALPS	- AUTODIN Limited Privacy Service
AMME	- Automated Multi-Media Exchange
AMPE	- Automated Message Processing Exchange
ARCS	- Automatic Reproduction Collocation System
ARPANET	- Advanced Research Projects Agency Network
ASC	- AUTODIN Switching Center
ASCII	- American Standard Code for Information Inter-Change
ASD/C^3I (ASD/CCCI)	- Assistant Secretary of Defense/Command Control Communications and Intelligence
ATMHS	- Automated Text Message Handling System
ATP	- Automated Telecommunications Program
ATCAP	- Army Telecommunications Automation Program
AUTODIN	- Automatic Digital Network

<u>C</u>

CARP	- Contingency Alternate Routing Plan
CCU	- Common Control Unit
COL	- Communications Oriented (High Order) Language
CONUS	- Continental United States
CPU	- Central Processing Unit
CRC	- Cyclic Redundancy Check
CCTC	- Command & Control Technical Center

CRITICOM	- Critical Communications
CRT	- Cathode Ray Tube
CSF	- Centralized Service Facility
CSIF	- Communications Services Industrial Fund
CSS	- Central Security Services
D	
DARPA	- Defense Advanced Research Projects Agency
DCA	- Defense Communications Agency
DIA	- Defense Intelligence Agency
DLA	- Defense Logistics Agency
DoD	- Department of Defense
DPI	- Data Processing Installation
DSSCS	- Defense Special Security Communications System
DSTE	- Digital Subscriber Terminal Equipment
DTACCS	- Director Telecommunications and Command and Control Communications Systems
E	
ECP	- Engineering Change Proposal
EIN	- Experimental Integrated Network
EUCOM	- European Command
F	
FIPS	- Federal Information Processing Standard
FYP	- Five Year Plan
G	
GAO	- Government Accounting Office
GENSER	- General Service

GFE	-	Government Furnished Equipment
H		
HSI	-	Host Specific Interface
I		
I/A	-	Interactive
IAS	-	Integrated AUTODIN System
IASA	-	Integrated AUTODIN System Architecture
ICATS	-	Intermediate Capacity Automated Telecommunications System
IOC	-	Initial Operational Capability
IRT	-	Interim Remote Terminal
J		
JCS	-	Joint Chiefs of Staff
K		
Kbits	-	Kilobits
Kbs	-	Kilobits per second
KDC	-	Key Distribution Center
L		
lb/s	-	Line Block per Second
LDMX	-	Local Digital Message Exchange
LRAN	-	Local-Regional Access Node
M		
Mbits	-	Megabits
MCCU	-	Multiple Channel Control Unit
MCEB	-	Military Communications-Electronics Board
MILDEPS	-	Military Departments

MIL-STD - Military Standard

MOP - Memorandum of Policy

N

NATO - North Atlantic Treaty Organization

NAVCOMPARS - Naval Communications Processing and Routing System

NCC - Network Control Center

NFE - Network Front End

NSA - National Security Agency

NTAP - Naval Telecommunications Automation Program

O

OCR - Optical Character Reader

OCRE - Optical Character Reader Equipment

O/S - Overseas

OSD - Office of the Secretary of Defense

P

PAC - Pacific

PACOM - Pacific Command

PLA-RI - Plain Language Addressing - Routing Indicator

PLAD - Plain Language Address Directory

P/S - Packet Switching

PSN - Packet Switch Node

PWIN - Prototype WWMCCS Intercomputer Network

Q

Q/R - Query Response

R

R&D - Research and Development

RDT&E - Research Development Test and Evaluation

ROC - Required Operational Capability

S

SCCU - Single Channel Control Unit

S&F - Store and Forward

SI - Special Intelligence

SIGINT - Signal Intelligence

SPP - Subsystem Project Plan

SRT - Standard Remote Terminal

T

TAM - Teletypewriter Adapter Module

TARE - Teletypewriter Automated Relay Equipment

TCC - Transmission Control Code

TTY - Teletypewriter

U

ULMS - Unit Level Message Switch

V

VAC - Value Added Carrier

VAN - Value Added Network

VDU - Video Display Unit

W

WIN - WWMCCS Intercomputer Network

WNFE - WWMCCS ADP Network Front End

WSEO	- WWMCCS System Engineering Organization
WWMCCS	- World-wide Military Command and Control System

APPENDIX 2

AMPE PHASE I/II ANALYSIS

APPENDIX 2

AMPE PHASE I/II ANALYSIS

1. This appendix includes information previously published as appendices to two AMPE comparison studies:

a. Phase 1 - Functional Comparison of Automated Message Processing Exchanges, 14 October 1976.

b. Phase 2 - Automated Message Processing Exchange Functional Comparison Study Phase II, 18 November 1977.

2. Part 1 compares the manner in which the four AMPEs perform the 32 selected functions, and also contains a description of the physical characteristics of the AMPEs. The 32 functions are divided into three categories:

a. AUTODIN System Requirements

b. Telecommunications Center Functions

c. Customer Assistance Functions

3. Part 2 of this appendix is a technical analysis of the 32 functions identified in Part 1. The analysis is based upon detailed data submitted by the Services/Agencies.

PART I

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
AUTODIN SYSTEM REQUIREMENTS	LINE PROTOCOL	MODE I THRU V OPERATION	MODE I TO ASC NON-DIN PROTOCOL TO TERMINALS	MODE I THRU V OPERATION	MODE I, II, V OPERATION
	CODE CONVERSION	ASCII, ITA#2	ASCII, ITA#2	ASCII, ITA#2, EBCDIC,BCD	ASCII, ITA#2
	ERROR CHECKS AND CORRECTION	CIRCUIT AND TRANSMISSION ERRORS; HARDWARE MALFUNCTION; READ/WRITE ERRORS; MISSENT MESSAGES: SUSDUPS: STRAGGLERS; OVERDUE MESSAGES; SECURITY VIOLATIONS; LOSS OF MESSAGE INTEGRITY; FORMAT ERRORS, HEADER INFO ERRORS.	SAME AS AMME	SAME AS AMME	CIRCUIT AND TRANSMISSION ERRORS SAME AS DSTE; READ/WRITE ERRORS; STRAGGLERS; SECURITY VIOLATIONS; LOSS OF MESSAGE INTEGRITY; FORMAT ERRORS; HEADER INFO ERRORS. MISSENT MESSAGES; HARDWARE MALFUNCTIONS.
	FIFO BY PRECEDENCE	YES	YES	YES	YES
	FLASH AND HIGHER PRECEDENCE PREEMPTION	YES	YES	YES	YES
	MULTIPLE DELIVERY OF SINGLE ADDRESS MESSAGES.	AUTOMATICALLY PROCESSES INCOMING AND OUTGOING AIG'S	SAME AS AMME	AUTOMATIC ON ADDRESSEE, OFFICE SYMBOL. STD. GENERAL MESSAGES, AS SPECIFIED BY USER.	SAME AS AMME
	MEDIA CONVERSION	SYSTEM REACTION TO LANGUAGE MEDIA FORMAT CODE IN MESSAGE HEADER. ALSO AVAILABLE BY CONSOLE COMMAND	SAME AS AMME	SAME AS AMME	SAME AS AMME
	HISTORY FILES AND LOGS	ALL INPUT/OUTPUT ON MAG TAPE.	ALL INPUT/OUTPUT ON MAG TAPE.	ALL TRAFFIC IS RETAINED ON MAG TAPE. MOST RECENT 30,000 MESSAGES AVAILABLE ON DISC FOR AUTO STORAGE AND RETRIEVAL. AUTOMATIC MESSAGE TRACE AVAILABLE.	ALL INPUT/OUTPUT ON MAG TAPE.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
TELECOMMUNICATIONS CENTER FUNCTIONS	DISTRIBUTION DETERMINATION OF INCOMING MESSAGES.	LINES 1 THRU 11, JANAP 128 FORMAT ARE ANALYZED ALONG WITH USER INPUT. DISTRIBUTION IS ANNOTATED ON MESSAGE. DEFAULT TO TRAFFIC MANAGEMENT POSITION FOR MANUAL ROUTING. PLANNED ENHANCEMENT INCLUDES TEXTUAL ANALYSIS OF FIRST LINE OF TEXT (USUALLY SUBJECT).	DETERMINED BY HEADER AND TEXTUAL ANALYSIS ALONG WITH USER INPUT. DEFAULT TO TRAFFIC MANAGEMENT VDU.	DETERMINED BY ANALYSIS OF RI, OFFICE SYMBOL, SUBJECT IDENTIFIER (SID) AND USER INPUT. DISTRIBUTION ANNOTATED ON ALL INCOMING MESSAGES. DEFAULT TO KVDT FOR MANUAL ROUTING.	DISTRIBUTION DETERMINED BY ANALYSIS OF FORMAT LINES 1-11, JANAP 128 AND 4A (DELIVERY DISTRIBUTION INDICATOR) AND 12 OF DOI 103 MESSAGE FORMAT.
	AUTOMATIC DISTRIBUTION OF INCOMING MESSAGES.	DETERMINED DISTRIBUTION IS CORRELATED WITH THREE CHARACTER INTERNAL ROUTING CODE ASSIGNED TO EACH CONNECTED REMOTE TERMINAL. AFTER TERMINAL STATUS AND SECURITY QUALIFICATION IS VERIFIED, MESSAGES ARE DISTRIBUTED AUTOMATICALLY. DEFAULT TO OTC DELIVERY.	YES. DEFAULT TO OTC DELIVERY.	YES. DETERMINED BY ANALYSIS OF RI, OFFICE SYMBOL, SUBJECT IDENTIFIER (SID) AND USER INPUT. DEFAULT TO KVDT FOR MANUAL ROUTING.	SAME AS AMME.
	DD FORM 173 TO JANAP 128 FORMAT CONVERSION.	YES	YES	YES	YES. ALSO DD173 TO DOI 103 FORMAT CONVERSION.
	PLA TO RI CONVERSION.	YES	YES	YES	YES
	JANAP 128/ACP 127 CONVERSION.	YES	NO. USES THIS CAPABILITY IN ASC. CONVERTS TO ACP126(M) WHEN REQUIRED.	YES	PLANNED ENHANCEMENT.
	INTERNAL DISTRIBUTION OF OUTGOING MESSAGES.	NOT AUTOMATIC AS CONFIGURED.	WILL DISTRIBUTE INTERNALLY TO OFFICES LISTED IN DISTR BLOCK OF DD 173	NOT AUTOMATIC AS CONFIGURED.	NOT AUTOMATIC AS CONFIGURED.

TYPE	FUNCTION/ CHRACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
TELECOMMUNICATIONS CENTER FUNCTIONS	READDRESSAL/ RETRANSMISSION	BY OPERATOR COMMAND FROM KVDT.	AUTOMATIC WITH OCR INPUT. NAVCOMPARS: ALSO CAPABLE OF BROADCAST SCREENING I.E. RETRIEVAL, SORTING AND RETRANS OF LARGE BLOCKS (TIME OR PSN) OF TRAFFIC TO SHIPS THAT HAVE BEEN OUT OF CONTACT.	BY OPERATOR COMMAND FROM KVDT.	BY OPERATOR COMMAND FROM KVDT.
	STATISTICS FILES	ON-LINE: AVERAGE SYSTEM PROCESSING TIME FOR NARR/DATA MESSAGES BY PRECEDENCE. OFF-LINE: MESSAGES/LB SENT/REC BY TERMINAL; TOTAL MESSAGES BY PRECEDENCE, CLASSIFICATION, AND TERMINAL; SYSTEM MESSAGES REJECTED/ CANCELLED BY TERMINAL AND CAUSE; DEVICE OUTAGE STATS. DATA GATHERED AND PROCESSED ON-LINE; RETRIEVED OFF-LINE.	IN/OUT MESSAGES PROCESSED. MESSAGES BACKLOGGED, SERVICED MESSAGES, DUPLICATES RECEIVED, MISROUTED MESSAGES, RETRANSMISSIONS, DISTRIBUTION SUMMARY STATS MAINTAINED ON-LINE. INFO SUMMARIZED ON REQUEST. ALSO GENERATES REQUIRED REPORTS.	CHANNEL MESSAGE QUEUE STATUS INDICATING THE NUMBER OF MESSAGES AND LINEBLOCKS BY PRECEDENCE AND CLASSIFICATION IS AVAILABLE. STATS ALSO IDENTIFY SYSTEM/PERIPHERAL CONFIGURATIONS, CHANNELS IN/OUT OF SERVICE. OLDEST MESSAGE. HIGH PRECEDENCE TRAFFIC, PLA USE, SERVICE MESSAGES AND MANY MORE.	MESSAGES/GROUPS BY COMM LINE INPUT; TOTAL IN/OUT; ORIG MESSAGES BY PRECEDENCE; SERVICE MESSAGES SENT/REC;RI'S ON ORIG MESSAGES BY PRECEDENCE WITH ORIGINATOR RI, TOF, TOR AND GR COUNT. LOG DUMPS AVAILABLE.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
TELECOMMUNICATIONS	INTRANSIT STORAGE	ALL TRAFFIC ENTERING SYSTEM IS STORED ON DISK BEFORE ACK IS GIVEN BY THE SYSTEM. INCLUDES SERVICE MESSAGES AND INTRASYSTEM TRAFFIC.	ALL TRAFFIC WRITTEN TO TWO DISKS BEFORE ACK.	ALL TRAFFIC WRITTEN TO DISK AND MAG TAPE UPON RECEIPT. ACK GIVEN WHEN EITHER PERIPHERAL HAS EOM.	ALL TRAFFIC TO DRUM BEFORE ACK. FROM DRUM TO DISK AND TAPE.
	OVERFLOW PROTECTION	MAG TAPE OVERFLOW FILE ACTIVATED BY TRAFFIC MANAGEMENT POSITION BASED UPON AUTOMATIC DISK SATURATION REPORTS.	AUTOMATIC	SYSTEM PROVIDES AUTOMATIC OVERFLOW TO MAG TAPE BASED UPON SENSING OF ALLOCATED DISC SPACE. THE % OF FILL AT WHICH OVERFLOW OCCURS IS CONFIGURABLE.	NO PROVISIONS IN THE SYSTEM.
CENTER FUNCTIONS	AUTOMATIC SERVICE MESSAGE GENERATION	AUTOMATICALLY RECEIPTS FOR INCOMING SERVICE MESSAGES AND GENERATES SERVICE MESSAGES CONCERNING NONCRITICAL ERRORS TO ORIGINATOR AND TO TRAFFIC MANAGEMENT POSITION.	LIMITED AUTOMATIC SERVICE MESSAGE GENERATION CAPABILITY AS CONFIGURED. POSSIBLE FUTURE ENHANCEMENT.	AUTOMATIC FOR CERTAIN TYPES OF CKT, HEADER OR MSG VALIDATION ERRORS.	AUTOMATICALLY RECEIPT FOR CERTAIN SERVICE MESSAGES. WILL GENERATE COMPS AND ZFX (OPEN NUMBERS) SERVICE MESSAGES. ALSO ACKS BY SERVICE MESSAGE FOR CERTAIN HIGH PRECEDENCE MESSAGES.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
TELECOMMUNICATIONS CENTER FUNCTIONS	AUTOMATION ASSISTED TRAFFIC MANAGEMENT	OPEN NUMBER, (USUALLY ONE TO FOUR) KVDTs DEDICATED TO TRAFFIC MANAGEMENT. PROVIDES TRAFFIC MANAGER IMMEDIATE ACCESS TO TRAFFIC STATISTICS AND SYSTEM PERFORMANCE DATA. ALSO PERMITS ROUTING CORRECTIONS (EXCLUDING FORMAT LINES 1 - 6 AND TEXT), SECURITY ERROR HANDLING, MESSAGE RETRIEVAL, JANAP 128 FORMAT MESSAGE ENTRY, ACCESS TO AUDIT TRAILS AND GENERATION OF TRAFFIC INDEX TO DPI SERVED ONLINE.	PROVIDES FOR FOUR (LDMX) TO SIX (NAVCOMPARS) KVDTs IN THE MESSAGE/ SERVICE CENTER FOR ROUTING AND SERVICE CLERKS. PROVIDES TRAFFIC MANAGEMENT CAPABILITY SIMILAR TO AMME.	MANAGEMENT OF TCC IS PERFORMED FROM SYSTEM CONSOLE WITH ASSISTANCE FROM THE SERVICE KVDT. CAPABILITY SIMILAR TO AMME EXCEPT DPI TRAFFIC INDEX WHICH IS NOT AN AF REQUIREMENT. EACH SYSTEM HAS 5 KVDT INCLUDING ONE PER PROCESSOR WHICH IS PART OF CONSOLE.	TRAFFIC MANAGEMENT FUNCTIONS PERFORMED FROM SYSTEM CONSOLE AND FROM CORRECTION STATIONS. CAPABILITY SIMILAR TO AMME.
	MESSAGE RETRIEVAL	ON LINE RETRIEVAL OF ALL NARRATIVE TRAFFIC FOR PAST 120 HOURS AND ALL DATA TRAFFIC FOR 6 HOURS BY COMMAND FROM THE TRAFFIC MANAGER. OLDER TRAFFIC AVAILABLE OFF LINE FROM HISTORY TAPES. BROAD RANGE OF RETRIEVAL PARAMETERS.	ON LINE RETRIEVAL OF A MINIMUM OF 15 DAYS ALL TRAFFIC BY PSN, DTG OR DTG/ORIGINATOR. UP TO SEVEN DAYS WITH OSRI SSN, OR TOF. SIX MONTHS OFF LINE	SYSTEM PROVIDES AUTOMATIC RETRIEVAL FROM A DATA BASE CONTAINING THE LAST 30,000 MESSAGES BY DTG. OSRI, SSN AND LMF. ON-LINE RETRIEVAL FROM HISTORY TAPE IS AVAILABLE FOR OLDER TRAFFIC.	AUTO RETRIEVAL FROM SYSTEM CONSOLE. RETRIEVAL PARAMETERS: CDSN (I/O) SSN RANGE, DTG, ORIGINATOR. RETRIEVAL DIRECTORY IS MAINTAINED. THRESHOLD ESTABLISHED LOCALLY BASED ON TRAFFIC VOLUME AND EQUIPMENT CONFIGURATION. AUTO-RETRIEVAL ON INCOMING ZFT, NO-KEY OR OPERATOR INTERVENTION. 24 HOURS ONLINE; 30 DAYS OFF LINE.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
TELECOMMUNICATIONS CENTER FUNCTIONS	ALT ROUTE CAPABILITY	ALT ROUTE CONDITIONS INVOLKED OR REVOKED BY CONSOLE OPERATOR. TYPES ALT ROUTE AVAILABLE: BY RI, BY RI/CIC,BY CIRCUIT MODULE (ALL TRAFFIC FOR TERM A TO TERM B), BY SECURITY LEVEL AND UP, BY PRECEDENCE AND UP, BY PRECEDENCE AND DOWN AND BY LMF. THIS CAPABILITY ALSO PROVIDES SELECTIVE INTERCEPT CAPABILITY.	SOFTWARE AVAILABLE FOR ALT ROUTE INITIATION FROM CONSOLE BY RI, BY SHORT TITLE, BY CHANNEL (ALL FOR TERM A TO TERM B), AND BY PRECEDENCE DOWN.	PRESENT STATUS OF ALL ROUTING SHOWN IN CURRENT STATISTICS. ALTROUTE CONDITIONS ARE INVOKED OR REVOKED BY OPERATOR CONSOLE COMMAND. TYPES ALTROUTES AVAILABLE: RI, SECURITY, PRECEDENCE, LMF, AND DESTINATION. THIS CAPABILITY PROVIDES FOR SELECTIVE INTERCEPT.	THROUGH CONSOLE COMMAND OR ASSIGNMENT OF MULTIPLE DDI'S.
	SPECIAL INTELLIGENCE TRAFFIC	PLANNED ENHANCEMENT	FIRST SITE: LONDON	ALTHOUGH NOT REQUIRED TO DATE, ATP CAN BE EXPANDED TO HANDLE SI TRAFFIC. FEASIBILITY STUDY IS CURRENTLY BEING ACCOMPLISHED TO DETERMINE WHAT WILL BE REQUIRED TO MEET ALL DIA SI SPECIFICATION AND CERTIFICATION.	YES

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
CUSTOMER ASSISTANCE	USER TO USER SERVICE	PROVIDES VIRTUAL CIRCUIT INTERCONNECT BETWEEN USERS THROUGH A SPEED BUFFER IF USER TERMINALS ARE EQUALLY SECURE.	NONE	PROVIDES MESSAGE TRANSMISSION BETWEEN REMOTES.	NONE
	AUTOMATED SUPERVISION OF MESSAGE PREPARATION.	DIAGNOSTIC MESSAGES IN LANGUAGE EASILY UNDERSTOOD BY NON-COMMUNICATOR, CLERICAL PERSONNEL ARE SENT TO ORGINATORS AUTOMATICALLY WHEN AN ERROR IS MADE DURING ENTRY PROCESS. TRAFFIC MANAGER IS ALSO NOTIFIED OF USER INPUT ERRORS AND HAS THE CAPABILITY TO PROVIDE PERSONAL ASSISTANCE IN MESSAGE ENTRY.	ACKNOWLEDGEMENT OR NEGATIVE ACKNOWLEDGEMENT ONLY.	SAME AS AMME.	SAME AS AMME.
	MESSAGE MASK CALLUP FROM REMOTES	JANAP 128, ACP127, DD173, SPECIAL HEADERS	NOT REQUIRED	JANAP 128, ACP 127, DD173 DOI 103 FOR CRITIC, SERVICE MSGS. USERS MAY DEVELOP A LIBRARY OF PREFORMATTED MESSAGES.	DOI 103 FORMAT FOR CRITIC MESSAGES, DD 173 FOR ALL OTHERS. AUTO-GENERATED BASED ON PLA.
FUNCTIONS	ELECTRICAL INTERFACE WITH DATA PROCESSORS	THREE METHODS: CHANNEL TO CHANNEL (100KB SPECIFIED, 35KB ATTAINED, 50KB EXPECTED); SHARED PERIPHERAL DEVICE; AND MAG TAPE REMOTE IN DPI. WWMCCS INTERFACE BEING DEVELOPED.	2400 BAUD INTERFACE WITH WWMCCS BETWEEN LDMX COMM CONTROL MULTIPLEXOR AND THE DATANET 355 THROUGH A BUFFER. ALL OTHER ADP INTERFACES WILL REQUIRE AUTODIN FORMATTING.	UP TO (8) 9600 BAUD WWMCCS INTERFACES USING THE DATANET 355. SEVERAL PROTOCOLS BEING DEVELOPED. SHARED DISC INTERFACES TO ADPs MAY BE SATISFIED. CHANNEL INTERFACE TO B3500 IS BEING DEVELOPED BY C3 INC.	NO SPECIAL PROVISIONS FOR ADP INTERFACE. ADP USERS TREATED AS ANY OTHER REMOTE MODE I USER.

TYPE	FUNCTION/ CHARACTERISTICS	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
CUSTOMER	PREPROCESSING OF MAGNETIC TAPE TRAFFIC.	SORTS MAG TAPE ON DPI REQUEST BY ANY ONE OR MORE OF SEVERAL PARAMETERS. MOST COMMON ARE RI, CLASSIFICATION, PRECEDENCE, CIC AND LMF. ALSO STORES MAG TAPE UNTIL CALLED FOR BY DPI. GENERATES A DPI TRAFFIC INDEX ON LINE WHICH CONTAINS THE NUMBER AND LENGTH OF MESSAGES HELD FOR THE DPI.	SAME AS AMME.	SAME AS AMME EXCEPT GENERATION OF DPI TRAFFIC INDEX	NO REQUIREMENT
ASSISTANCE	AUTOMATED ACP 117 MAINTENANCE	ALL AMMEs HAVE SUBSET OF ACP117 IN STORAGE. EACH SITE UPDATES AS REQUIRED FROM TRAFFIC MANAGEMENT POSITION.	RECEIVES DAILY ACP117 UPDATE DATA ELECTRICALLY. SEE ON-LINE LOCATOR.	SAME AS AMME	NO REQUIREMENT
	FLEET BROADCAST KEYING	NO CAPABILITY	NAVCOMPARS ONLY: ONE BROADCAST TO ALL SHIPS. ON-LINE TO 17 CHANNELS. EDITING FOR BROADCAST.	NO CAPABILITY	NO CAPABILITY
FUNCTIONS	SHIP TO SHORE COMMUNICATIONS	NO CAPABILITY	NAVCOMPARS ONLY: ON/OFF LINE TERMINATION OF SHIP TO SHORE RATT CIRCUITS.	NO CAPABILITY	NO CAPABILITY
	ON LINE LOCATOR	NO REQUIREMENT	NAVCOMPARS ONLY: LOCATION OF ALL SHIPS IS MAINTAINED ON LINE AT ONE NAVCOMPARS. ACP117 IS UPDATED ACCORDING TO LOCATION CHANGES. ACP117 UPDATE IS TRANSMITTED ELECTRICALLY TO ALL LDMX AND NAVCOMPARS DAILY.	NO REQUIREMENT	NO REQUIREMENT

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
PHYSICAL	HARDWARE	UNIVAC 9400 CPU WITH DCT 9000 PERIPHERAL CONTROLLER UNIVAC LTC 16 LINE TERMINATION CONTROLLER, DLT 70 AUTODIN INTERFACE. AMME-E HAS 2 UNIVAC 9400 CPU WITH DCT 9000 PERIPHERAL CONTROLLER.	LDMX: UNIVAC 70/45 CPU WITH 2 MODEL 1600 AUTODIN TERMINALS. USES COMMUNICATIONS CONTROLLER, MULTICHANNEL (CCM) FOR LINE TERMINATION CONTROL. NAVCOMPARS: SAME AS LDMX WITH TWO UNIVAC 70/45 PROCESSORS FOR SYSTEM RELIABILITY ONLY. NAVCOMPARS II/LDMX II: U70/45 REPLACED WITH U90/60. CCM REPLACED WITH UNIVAC 3760 FEP.	C3INCORPORATED.RESTON VA PROVIDING INTERDATA 7/32 (32-BIT) PROCESSORS. ATP5: 2 PROCESSORS ATP6: 3 PROCESSORS ATP IS A FULLY REDUNDANT SYSTEM WITH SOFTWARE FUNCTIONS DISTRIBUTED BETWEEN PROCESSORS.	INFORMATION SYSTEMS (IS) 1000 MINI PROCESSORS (FORMERLY TEMPO II).DSTE CCU IS USED AS AUTODIN INTERFACE.
CHARACTERISTICS	INTERNAL PROGRAMMABLE MEMORY	262K BYTES MAX	U70/45: 512K BYTES MAX. UNIVAC 90/60: 2M BYTES VIRTUAL.	325K BYTES IN SYSTEMS SERVING 30 COMMUNICATIONS LINES. MEMORY IS EXPANDABLE IN 32K BYTE INCREMENTS TO A MAXIMUM OF 1 MILLION BYTES.	SMALL: 40K BYTES. MEDIUM: 48K BYTES. LARGE: 56K BYTES. MAXIMUM: 256K BYTES.
	SOFTWARE	MODULAR; ALC; USACC CENTRAL MAINTENANCE	MODULAR; ALC (70%), COBOL (30%); CENTRAL MAINTENANCE BY NAVCOSACT	MODULAR AND TRANSPORTABLE BETWEEN A WIDE CLASS OF MODERN HARDWARE SYSTEM. SOFTWARE WRITTEN COMMAC WHICH ALLOWS RE-IMPLEMENTATION OTHER HARDWARE SYS.	MODULAR; ALC.
	PERIPHERALS	CARD READER/PUNCH, PRINTERS, PAPER TAPE READER/PUNCH, KVDT (VDU, CRT), 7/9 TRACK MAG TAPE, DISK AND DRUM MASS STORAGE DEVICES; NECESSARY PERIPHERAL CONTROLLERS ALL UNIVAC. ON LINE CRYPTO.	SAME AS AMME. ALSO COGNITRONICS OCRE.	PERIPHERALS ARE PROVIDED AND MAINTAINED BY C3 INC, EXCEPT OCRE PROVIDED BY LUNDY FARRINGTON CORP. REMOTE TERMINALS AND SUPPORTING EQUIPMENT WILL BE LEASED (VENDOR NOT YET IDENTIFIED).	CARD READER/PUNCH IS DSTE; KVD PRINTERS, PAPER TAPE READER/PUNCH BY TELETYPE CORP. OCR BY COMPUSCAN; DISK/DRUM MSD, MAG TAPE HANDLERS (9 TRACK), FROM GTE. ON LINE CRYPTO.

TYPE	FUNCTIONS/ CHARACTERISTIC	AMME-BASIC AMME-EXPAND	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
PHYSICAL	INPUT/OUTPUT SPEEDS	COMM LINES: 60-256K BD REMOTE TERM: 60-19.2K BD DPI INTERFACE: 100K BD AUTODIN: 9.6K BD (NOW 4.8K BD)	TERMINALS: 60-2400 BD AUTODIN: 1200-2400 BD	ASYNCHRONOUS: 75-9600 BAUD SYNCHRONOUS: - 1200-1.6M BAUD* NO REQUIREMENT OVER 9600 BAUD ARE IDENTIFIED AT THIS TIME.	AUTODIN: 1200 BD (LIMITED BY DSTE CCU)
	RECOMMENDED INSTAL-LATION AREA	AMME-B - 2500 SQ FT AMME-E - 3000 SQ FT	LDMX- 2000 SQ FT. NAVCOMPARS - 2500 SQ FT	ATP 5: 600 SQ FT MIN., 1200 SQ FT OPTIMUM ATP 6: 800 SQ FT MIN., 1600 SQ FT OPTIMUM	1000-2500 SQ IT (BASED ON CONFIGURATION)
	POWER REQUIREMENTS	50-60HZ; 110/220V ~100 KVA	50-60HZ; 110/220V 90-100 KVA	ATP 5: 50-60KVA ATP 6: 60-65KVA POWER IS 110V AND 208V SINGLE PHASE.	50/60HZ 110/220V 90-170 KVA BASED ON CONFIGURATION
CHARACTERISTICS	ENVIRONMENTAL CONDITIONING	AIR CONDITIONING/HUMIDITY CONTROL REQUIRED. RAISED FLOORING SPECIFIED.	SAME AS AMME	20-25°C 40%-60% HUMIDITY GOVERNMENT WILL PROVIDE CABLE CHANNELS BUT NOT RAISED FLOORING.	AIR CONDITIONING AND HUMIDITY CONTROL.
	TERMINATION CAPACITY	MAX OF 64 USING FOUR LTC 16's. PRACTICAL LIMIT IS 48 AS CONFIGURED. EXPANDABLE TO 256 USING U3760 ILO LTC 16'S, BUT LOSS OF THROUGHPUT IS RESTRICTING.	48 TO 255 (DEPENDING ON MIX OF HIGH AND LOW SPEED TERMINALS)	NOMINAL: 30 LINES. THEORETICALLY EXPANDABLE TO 1024 INTERRUPTS; CORE LIMITATIONS ESTABLISH A PRACTICAL LIMIT OF 200 1200-2400 BAUD LINES.	SMALL: 16 MEDIUM: 16 EXPANDABLE TO 32 LARGE: 32 EXPANDABLE TO 48.
	THROUGHPUT	SPECIFIED: 26 LINE BLOCKS PER SEC (LB/S). ACHIEVED: 16 OR 40 LB/S DEPENDING ON DEFINITION.	7-9 LB/S (BASED UPON SYSTEM CAPACITY OF 7K-8K MESSAGES/DAY OF STANDARD MIX). LDMX II/ NAVCOMPARS II: ~20 LB/S.	72 LBS/SEC, LIMITED BY DISC ACCESS SPEED AND DISC BUFFER (CORE) SIZE. THE ATP 6 PROVIDES GREATER CAPABILITY.	NOT SPECIFIED. NSA WILL PROVIDE WHEN AVAILABLE.

TYPE	FUNCTIONS/ CHARACTERISTIC	AMME-BASIC AMME-EXPAND	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
PHYSICAL	FAILSOFT	AMME-B: UPON U9400 FAILURE, ONE DLT 70 AND 4 TAPE DRIVES ARE SWITCHED TO DCT 9000. DCT 9000 CARD AND NARRATIVE CAPABILITY PROVIDE OTC SERVICE UNTIL U9400 IS RESTORED. AMME-E: SECOND U9400 ASSUMES FUNCTIONS OF FAILED U9400. DPI INTERFACES ARE DISCONTINUED. DPI TRAFFIC TO TAPE INTERCEPT.	ONE MODEL 1600 AUTODIN TERMINAL HAS AUGMENTED INTERNAL MEMORY. UPON U70/45 FAILURE, I/O CONTINUES W/AUTODIN (MODE I). CUSTOMER SERVICE OTC.	ATP 5/6 SYSTEMS ARE FULLY REDUNDANT. ALL COMMUNICATIONS LINES AND PERIPHERAL DEVICES ARE MANUALLY SWITCHABLE BETWEEN PROCESSORS. A FAILED DISC OR PROCESSOR MAY REQUIRE SYSTEM RECONFIGURATION. A SINGLE PROCESSOR SYSTEM WILL PERFORM ALL SYSTEM FUNCTIONS AT REDUCED THROUGHPUT.	FULLY REDUNDANT SYSTEM (EXCEPT ONE SMALL CONFIGURATION). DSTE CCU HAS NO FAILSOFT CAPABILITY AND WILL CONTINUE TO RECEIVE TRAFFIC WHEN REST OF SYSTEM IS DOWN. THIS TRAFFIC IS NOT RECORDED AND MUST BE RETRANSMITTED FROM ASC AFTER SYSTEM RESTORAL. LATTER WILL BE CORRECTED.
CHARACTERISTICS	EXPANDABILITY	U9400 REPLACEABLE WITH U90/60 OR U90/70. LTC 16 REPLACEABLE WITH U3760 FEP.	LDMX I/NCP I: NONE LDMX II/NCP II: U90/60 REPLACEABLE WITH U90/70.	THE MULTI-MINI SYSTEM DESIGN PROVIDES EXPANSION TO 256 LINES, 1 MILLION BYTES CORE WITHOUT CHANGING PROCESSORS.	SMALL AND MEDIUM SYSTEMS EXPANDABLE TO LARGE SYSTEM.
	COMMUNICATIONS LINE MONITORING AND ANALYSIS	HAS PATCH AND TEST FACILITY AT EACH INSTALLATION.	DEPENDS UPON BASE TECH CONTROL FACILITY.	SAME AS LDMX	LINE MONITORING CAPABILITY AT SYSTEM CONSOLE.
	RESTART/RECOVERY	RECOVERY PERFORMED BEFORE ON-LINE OPERATIONS RESUMED. MAY/MAY NOT REQUIRE DISK/TAPE REBUILD. RESTART IS RUN AS BACKGROUND AFTER ON-LINE OPERATIONS ARE RESUMED. HAS "FAST REBUILD" CAPABILITY. (UNDELIVERED MESSAGES ONLY).	SIMILAR TO AMME	AUTOMATIC RECOVERY PROCEDURES RESTORE THE SYSTEM TO NORMAL AFTER CORRECTION OF SYSTEM MALFUNCTION. WHEN A MALFUNCTION IS DETECTED, THE SYSTEM WILL TERMINATE ALL COMMUNICATIONS, ANALYZE THE FAULT, NOTIFY THE OPERATOR IN PLAIN LANGUAGE.	RECOVERY IS SPECIFIED AS AUTOMATIC AFTER CORRECTION OF FAULT. RESTART IS ACCOMPLISHED BY REBUILD, INITIALIZATION OF OFF-LINE SYSTEM. REBUILD IS BY RETRANS FROM ASC.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC BASIC-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
PHYSICAL	APPROXIMATE COST	(DELETED)	(DELETED)	(DELETED)	(DELETED)
	PROCUREMENT STATUS	1973 CONTRACT W/UNIVAC PROVIDES FOR UP TO 35 SYSTEMS; 24 SYSTEMS MUST BE PROCURED BEFORE 1980.	LDMX I/NAVCOMPARS I: PROCUREMENT COMPLETE. LDMX II/NAVCOMPARS II: BEING PROCURED FROM THE UNIVAC AMME CONTRACT.	CONTRACT FOR 6-8 SYSTEMS DEPENDING UPON CONFIGURATION WAS AWARDED 12 SEP 77. TEST FACILITY SCHEDULED FOR JAN 78	CONTRACT WITH GTE BEING IMPLEMENTED FOR SYSTEMS. ALL SYSTEMS SHOULD BE DELIVERED BY AUG 1977. GOVERNMENT IS INSTALLING.
CHARACTERISTICS	TEMPEST COMPLIANCE	YES	YES	UNDER REVIEW	YES
	INSTALLATIONS Up-to-date AMPE numbers are provided in Section III.C.	BASIC / EXPANDED CONUS 3 / 12 PAC — / 2 EUR — / 4 TOTAL: 3 / 18	CONUS / PAC / EUR LDMX I 11 / 4 / 1 LDMX II 1 / — / 1 NCPI 1 / 2 / 1 NCPII 1(2) / (2) / (1)* TOTAL 14 / 6 / 3 *All NAVCOMPARS I WILL BE UPGRADED TO NAVCOMPARS II. NAVCOMPARS I's WILL BE REUTILIZED AS 8 LDMX Is.	(8) ATP 5 FACILITIES ARE EXPECTED. LOCATIONS WILL BE IDENTIFIED BY THE AIR FORCE AS SOON AS TELECOMMUNICATIONS CENTER CONSOLIDATION STUDIES WILL PERMIT.	SMALL / MED / LARGE ARMY 0 / 2 / 3 NAVY 2 / 9 / 4 AF 3 / 5 / 2 NSA 0 / 2 / 0 TOTAL 5 / 18 / 0 + 2 UNCOMMITTED SYSTEMS
	TESTBED	FT HUACHUCA AZ	LDMX I/NAVCOMPARS I: WASHINGTON NAVY YARD, WASHINGTON, D.C. LDMX II/NAVCOMPARS II: CHELTENHAM, MD.	AFCS (CCPC) TINKER AFB OKLA.	TESTING IS DONE AT CONTRACTOR FACILITIES.

TYPE	FUNCTION/ CHARACTERISTIC	AMME-BASIC AMME-EXPANDED	LDMX I/II NAVCOMPARS I/II	ATP 5/6	STREAMLINER
PHYSICAL	OPERATIONS PERSONNEL REQUIRED	37	LDMX: 43 NCP: 58 INCLUDES REPRODUCTION/ DISTRIBUTION PERSONNEL.	MANNING STANDARD UNDER DEVELOPMENT.	SMALL: 15 MED: 25 LARGE: 30
	HARDWARE MAINTENANCE	(DELETED)	(DELETED)	(DELETED)	(DELETED)
CHARACTERISTICS	SOFTWARE MAINTENANCE	CONTRACTOR: 2 UNIVAC PRO-GRAMMERS FOR 1 YEAR. 19 GOVERNMENT PERSONNEL AT SOFTWARE SUPPORT CENTER. 8 GOVERNMENT PERSONNEL IN FIELD TO BE INCREASED TO APPROXIMATELY 16 AS ADDITIONAL SYSTEMS ARE INSTALLED.	GOVERNMENT PERSONNEL: $750K/YEAR LOCATED AT NAVCOSSACT AND 2 FIELD SITES: NORFOLK AND OAHU.	SOFTWARE MAINT. CONCEPT IS BEING REVIEWED. TOTAL SOFTWARE SUPPORT OF OPERATIONAL SYSTEMS, IS ESTIMATED AS LESS THAN 25 MAN YEARS PER YEAR.	BY NSA CODE T42. 7 PERSONNEL

PART 2

ANALYSIS OF FUNCTIONS

1. Constraints. The physical comparison charts in Part 1 indicate a broad range of processor capabilities. Three important characteristics are shown:

Throughput	7-72 Line Blocks/Second
Terminal capacity	16-255 remotes
Storage - core	40K-512K Bytes

a. The ranges of throughput and storage impose limitations on the performance of the selected 32 functions. The functional descriptions of reference (a) do not always consider these differences in characteristics. As an example, smaller STREAMLINERS, with storage of 80K, 96K, or 112K bytes could not be expected to perform the same functions in the same manner as an AMME, a U 90/60, or an ATP 5/6. The latter all have storage up to 256K Bytes storage per processor.

b. Another constraint is the cost of the AMPEs. The costs tabulated in reference (a) show that system costs range from (DELETED) STREAMLINERs without peripherals are (DELETED) while a NAVCOMPARS II with full line of peripherals is shown as (DELETED) Again, the smaller processors at the lower prices could not be expected to perform these functions equally well as a larger processor at the higher end of the cost range.

2. AUTODIN System Requirements.

a. The following functions are required within the AUTODIN system:

(1) Line Protocol

(2) Code Conversion

(3) Error Checks & Correction

(4) FIFO by Precedence

(5) FLASH and Higher Preemption

(6) Multiple Delivery of Single Address Messages

(7) Media Conversion

(8) History Logs and Files

b. Since all AMPEs perform all the above functions, this analysis is keyed on the exceptions noted. The manner of performance varies as indicated.

(1) Line Protocol. All AMPEs are standardized in the line protocol used to the AUTODIN ASC. In the area of line protocol to terminals, there are minor differences. All AMPEs are programmable to perform a variety of protocols. Current usage in some AMPEs is limited to a few protocols. There are no major obstacles to standardization of this function.

(2) Code Conversion. All AMPEs can be programmed for any required code. Each AMPE accepts different transmission codes, and thus requires different code conversions. ATP has numerous conversions. AMME accepts numerous common codes, and prefers to use a single transmission code to terminals. STREAMLINER accepts ITA-2 or ASC II.

(3) Error Checks and Correction. All AMPEs perform security checks. AMME and LDMX check the same types of error conditions. STREAMLINER performs additional security checks, and ATP performs all required AUTODIN I security checks. One unique feature was noted in STREAMLINER, where the "stutter" group (QQQ) signifies end of classification (stutter group suppressed on output).

(4) FIFO by Precedence. LDMX provides function on both input and output, maintaining three separate queues. LDMX provides SI to GENSER ratio for FLASH messages. Both STREAMLINER and LDMX provide FIFO on input messages, and provide features in support of fleet broadcast function. ATP processes all traffic FIFO by precedence.

(5) FLASH and Higher Preemption. Preempted messages are restored to top of queue in AMME, ATP, and STREAMLINER. The STREAMLINER identifies that acknowledgement of receipt to FLASH or higher precedence messages are performed within this function. All perform FLASH overrides. (See para f(6) below - Automatic Service Message Generation).

(6) Multiple Delivery of Single Address Messages. The capability of performing this function is dependent upon the AIG file size. The AIG file size varies from 200 (expandable) for ATP, up to 32,000 for LDMX. The number of RIs causing multiple separate messages vary from 500 in AMME and STREAMLINER up to 5,100 in LDMX. ATP updates AIG automatically, while STREAMLINER, AMME, and LDMX update in the background mode. (500RI is a procedure limit in STREAMLINER; ATP limited only by available auxiliary storage).

(7) Media Conversion. This function depends upon the media that an AMPE uses. AMME offers more media conversion capabilities than others. STREAMLINER and LDMX offer lesser conversions than AMME, and ATP offers less than others, but can be expanded. STREAMLINER currently limited to card media, but plans magnetic tape enhancement.

(8) History Logs and Files. The manner of performance is not standardized. The storage media are different. The retention times are not standardized, and variations on IAS from 6 hours data retention in AMME to 15 day retention in LDMX. All AMPEs record history tapes for longer retention. ATP enhancement planned will provide 15 day on line retention.

3. Telecommunications Center Requirements.

a. Only one of the fifteen Telecommunications Center Requirements shows full commonality:

DD 173/JANAP 128 Conversion.

Like the AUTODIN System Requirement Functions, this function had a DoD standard to guide implementation.

b. Of the remaining 14 functions, two show significant differences in performance. These are:

(1) JANAP 128/ACP 127 Conversion. This function was listed in Part 1, however, the data submitted for the Phase II AMPE Comparison Study indicates that no AMPE uses the function. It will be dropped as an AMPE function. The capability is present in the AUTODIN ASC.

(2) SI Traffic. The data submitted indicates that this function is available in STREAMLINER and LDMX/NAVCOMPARS. Also, the AMME will be modified to handle SI traffic; the ATP has no present requirement for this function, but is reviewing the need for this capability.

c. The remaining 12 of the 15 Telecommunications Center Functions exhibit varying degrees of commonality. These functions are:

(1) Distribution Determination of Incoming Messages

(2) Automatic Distribution of Incoming Messages

(3) PLA/RI Conversion

(4) Internal Distribution of Outgoing Messages.

(5) Readdressal/Retransmission

(6) Statistical Files

(7) Intransit Storage

(8) Overflow Protection

(9) Automatic Service Message Generation

(10) Automation Assisted Traffic Management

(11) Message Retrieval

(12) Alt Route Capability

d. As a result of the analysis of each function there is a distinct commonality exhibited, in that all AMPEs perform each of these 12 functions. However, there is less than full commonality in the manner in which these functions are performed. In the absence of DoD standardization in the Telecommunications Center Requirements functions, each of the Services/Agencies developed their own functional design to meet validated requirements.

e. Within the Telecommunications Center Requirements, there are three functions associated with the determination and distribution of incoming and outgoing messages. These distribution functions have been identified by Service/Agency Communicators as problem areas, since some Administrative Officers exercise a degree of control in defining the specification and use of these functions. An analysis of these three functions indicated the following:

(1) Distribution Determination of Incoming Messages. This is a function which determines internal routings, and records distribution on messages. The disparities can be recognized by examination of the parameters used. AMME uses PLA, RI, Official Title and Office Symbol to route narrative traffic; and uses three parameters (CIC, DSRI, OSRI) for data traffic. LDMX is data base dependent, using text analysis, as well as the RI, side route and short title. The ATP uses the RI, plus message elements (OPR address, info address, and exempt address). ATP proposes to use a Subject Identifier (SID) group. STREAMLINER establishes internal routing based upon a unique 3-letter (trigraph) indicator in Format Line 4a.

(2) Automatic Distribution of Incoming Messages. This function refers to the capability of an AMPE to make

internal distribution of incoming messages with a minimum of human intervention. The use of this function can be gauged by the ratio of messages delivered without human intervention.

(a) In AMME, distribution to users is automatic for messages where distribution has been determined. Messages not automatically distributed are referred to traffic management position for operator intervention. However, this analysis is limited because the percentage of automatic distribution is not available.

(b) Another example is that this function is fully automatic in LDMX/NAVCOMPARS, with default for operator assistance to VDT. Further default to service position if VDT operator unable to process. Consequently, 94% of messages handled are routed automatically.

(c) In ATP, distribution to users is automatic for messages which distribution has been determined. Successful automatic distribution can approach 100%, since it is only limited by the array with where the user builds his file. Messages not automatically addressable by user file reference are displayed for operator/distribution officer distribution determination via KVDT.

(d) In STREAMLINER the incoming RI is examined and the associated DDI is compared with the DDI on Format Line 4A, and if matched, the associated distribution is appended for output. If no match, message goes to CRT for operator intervention. In STREAMLINER, 98% of messages are automatically distributed.

(3) Internal Distribution of Outgoing Messages. Function includes all methods of distribution of copies of outgoing messages to offices/agencies within the origination command.

(a) AMME uses routing and distribution file, and narrative distribution parameters: RI, AIG, Official Title, and Office Symbol. AMME routes Data Traffic by DPI Preamble.

(b) LDMX permits user to add back scatter distribution in "DISTR" block of DD 173. The LDMX can use the action or info line addressees to determine back scatter distribution.

(c) ATP permits addition of local RI, and use of message distribution function. With OCR, originator can specify come-back copy. ATP does not read or recognize distribution block on DD 173; however, this capability could be readily provided.

(d) STREAMLINER performs function by originator option on a per input line basis.

f. The three distribution type functions have been discussed in a group; however, it is useful to discuss the remaining nine functions separately.

(1) **PLA/RI Conversion.** All AMPEs perform the function with different capacities and features. Reporting of capacities used different definitions of parameters. For example, the maximum number of PLA or RIs stored vary from 500 maximum RIs (AMME) to 32,000 PLAs (LDMX). STREAMLINER reports no limit on maximum PLA/RIs size. ATP reports a maximum of 10,000 PLA-RIs, limited only by available auxiliary storage. STREAMLINER includes the RI in the PLA table.

(2) Readdressal/Retransmission.

(a) Readdressal. In AMME, readdressal is manual, performed by operator. ATP has no on-line message files, so the function is manually performed by service message or KVDT input. LDMX accomplishes this function by entering the modified ACP 126 readdressal request. This causes LDMX to retrieve the message from on line file, append the appropriate RIs and releases the message. In STREAMLINER, the message is retrieved from on line file, the operator adds readdressal heading to original message text, and reintroduces message into the system.

(b) Retransmission. Retransmission in ATP is manual. The AMME operator retrieves message from on-line file, types in retransmission command, and releases message. System routes on new RIs using original message text. Any message sent by LDMX may be retransmitted from VDT position. Retransmission instructions are appended to message text after retrieval from on line storage, and released to system. NAVCOMPARS provides unique support for retransmission and operator controlled retransmission is available. STREAMLINER automatically recognizes retransmission request and retransmits message automatically. Also retransmits when open message numbers are found.

(3) Statistical Files. All AMPEs have extensive capability for storing, retrieving, and generating statistical files. There is little commonality in the manner in which function is performed, or in the statistics maintained. The basis for the establishing statistical files is not uniform, as reported for this study. For example:

- LDMX and ATP files are based on the number of messages.

- AMME files based on number of line blocks.

- STREAMLINER files based on number of messages/ groups.

(4) In Transit Storage. All AMPEs provide in transit storage, utilizing different storage media. AMME and ATP store on a disk, LDMX simultaneously on two disks, and STREAMLINER stores on a drum, then on a disk. In addition, all AMPEs provide:

- Storage function before acknowledgement (ACK).

- History or journal tapes for recovery and historical files.

(5) Overflow Protection. AMME and LDMX require operator intervention. AMME notifies console operator when in transit file exceeds predetermined saturation point. Operator can provide space, using system purge routine, by removing all delivered messages from disk intransit file. LDMX uses an intercept queue, and processes the queue if overload is approached. STREAMLINER uses a disk to back up the drum in the event an overload is approached. ATP provides function by writing an overload tape, if operator does not initiate action.

(6) Automatic Service Message Generation. ATP automatically generates service message to input terminal on detection of errors. AMME automatically generates service messages at header validation time. STREAMLINER performs numerous checks and some special security checks which result in automatic service message generation. Both STREAMLINER and LDMX/NAVCOMPARS perform similar services in support of Navy broadcast feature. ALL AMPEs route service message to console positions or to AMPE printer as required. LDMX uses this function for FLASH acknowledgement. (See also Para 2a(5) FLASH and Higher Preemption).

(7) Automation Assisted Traffic Management. Both AMME and ATP perform this automated function, while STREAMLINER and LDMX/NAVCOMPARS furnish statistics on operator request. ATP generates statistics automatically every 30 minutes. AMME generates some statistics automatically on a periodic basis while other statistics are available on request. Some statistics involve hardware, most involve system activity, queue status and other operational statistics. Function is very useful, but different in all AMPEs.

(8) Message Retrieval. AMME, LDMX and STREAMLINER perform message retrieval function on-line, while ATP is planning similar enhancement. Statistical data on message retrieval function are:

- AMME retrieves past 120 hours narrative and past 6 hours data traffic.

- LDMX retrieves on-line if resident on message disk (10-15 days)

- ATP will retrieve last 30,000 messages on-line (planned enhancement)

- STREAMLINER reports a variable retrieval period based on local equipment configuration and traffic volume.

(9) Alt Route Capability. Alt routing functions under operator control in all AMPEs. ATP can also initiate function by card input which results in system configuration. STREAMLINER assigns logical destination to alternate transmit channel. AMME, LDMX, and ATP uses a variety of alt route parameters, such as: RI, SSI, Channel ID, Precedence Group. These can be used individually or in combination.

4. Customer Assistance Requirements. Nine functions were designated Customer Assistance Requirement functions. The following analysis indicates little standardization in the performance of these functions.

a. Three of these Customer Assistance Requirements are unique, and not common to all AMPEs, while the other five functions show variations in the manner of performance. Specifically, the following Customer Assistance Requirement functions are considered unique: Broadcast Keying; Ship-to-Shore Communications, and On-Line Locator.

(1) Broadcast Keying is unique to NAVCOMPARS and STREAMLINER.

(2) Ship-to-Shore Communications is unique to NAVCOMPARS and STREAMLINER.

(3) On-Line Locator is unique to NAVCOMPARS.

b Within the remaining six functions some commonality exists, but many variations are noted. These six functions are: User-to-User Service; Automatic Supervision of Message Preparation; Message Mask Call-up from Remotes; Electrical Interface with Data Processors; Preprocessing of Magnetic Tape Traffic; and Automated ACP 117 Maintenance.

(1) User-to-User Service. ATP and LDMX/NAVCOMPARS and STREAMLINER use RIs for routing messages between remotes; AMME uses a single card CSU connection request to establish connection. ATP can handle multiple routed messages, using line segregation concept. LDMX handles user-to-user messages in a similar manner as other messages are handled; in that messages are queued FIFO to output channels, are accepted in JANAP 128 or Modified ACP 126 formats. SRT can initiate this mode (CSU) via a system control message.

(2) Automatic Supervision of Message Preparation. All AMPEs provide some assistance to the message writer, but the STREAMLINER provides assistance only to OCR message preparation. Others provide some sort of on-line assistance. LMDX/NAVCOMPARS provides an automated service to VDU operator at the AMPE, and also provides service to OCR preparation. ATP provides service in event of input error. Also provides manual assistance in return copy of DD 173. AMME and ATP offers diagnostic messages in plain language to assist operators at SRTs and IRTs. ATP and AMME have the most capability in the performance of this function.

(3) Message Mask Call-up from Remotes. LDMX does not provide this function, since the message masks reside in the Remote Information Exchange Terminal (RIXT). AMME, ATP, and STREAMLINER all provide a mask for DD 173. In addition, AMME provides an IRT and SRT mask, ATP provides a JANAP 128 and ACP 127 mask. In ATP, users may also store varied DD 173 masks which cannot be used by others. STREAMLINER provides a series of masks, classified as: OCR/CRT Simulator Mask, CRITIC Format, Message Fix, and CRT Protocol.

(4) Automated ACP 117 Maintenance. AMME performs the RI table update in background routine, using operator initiation. LDMX performs most updates on line, but cannot add a short title on line. ATP performs update on line, or via OCR, which include: additions, deletions, and changes. ATP records those PLA and AIG which are not maintained and provides a later print out of these requests. STREAMLINER performs this function either on line or off line.

(5) Electrical Interface with Data Processors. All AMPEs have some capability to support this function, but variations are noted. AMME accepts unique preamble format preceding the DPI traffic, then formats the DPI traffic IAW JANAP 128 G. ATP provides function for WWMCCS, and is readily expandable for other users. LDMX/NAVCOMPARS does not support the function, since it is limited to data pattern (card image) traffic only. STREAMLINER also supports the function.

(6) Preprocessing of Magnetic Tape Traffic. AMME has capability of sorting traffic prior to output to DPI; although DPI may request transmission using unique preamble. LDMX/NAVCOMPARS magnetic tape processing is limited to data pattern (card image) only. Files of traffic, stored in data pattern may be transmitted to remotes. ATP supports function from AUTODIN to remotes and from remotes to AUTODIN. STREAMLINER does not support function.

c. The two data processing support functions above were also reviewed with reference to the provisions of JCS MOP 165, which is quoted in part:

Para. 2.a. "AUTODIN will be used to satisfy narrative record and data communications requirements unless it is determined that AUTODIN cannot meet the requirements."

Para. 3.d. lists the functions that an AMPE may provide if required.

Para. 2.j. "Pre-processing and post-processing services of DPI will not normally be provided by the AMPE. However, where feasible and mutually agreed upon, this processing may be provided by the AMPE."

APPENDIX 3

IASA

TELECOMMUNICATIONS FUNCTIONS

APPENDIX 3

1. This appendix lists the baseline telecommunications functions required in the near-term (1978-83) Integrated AUTODIN System. The functions have been identified and allocated to the elements of the baseline architecture consisting of terminals and nodal facilities with an AUTODIN II backbone (Part 1), and further categorized by priority (Part 2).

2. Description of Elements.

a. Nodal facilities include AUTODIN II Packet Switching Nodes, AUTODIN I ASCs and AMPEs. Part 1 contains the functions assigned to one or more of these elements.

b. Terminals include all elements of the baseline architecture at which record traffic is entered into the system or which directly service message addressees. Included are telecommunications centers which have no remote terminals, remote terminals served by a nodal processor, host processors, and terminals of a host processor not directly connected to AUTODIN.

c. Some functions are necessarily performed by all elements of the architecture.

3. The categories of telecommunications functions listed in Part 2 are defined as follows:

CATEGORY I: Minimum Essential. Those functions required to support the basic IAS architecture.

CATEGORY II: Operative Functions. Those functions designed to minimize operational effort and to maximize effective and efficient service.

CATEGORY III: State-of-the-Art. Those functions that depend on the developing state-of-the-art and may be validated in the future as a Minimum Essential or Operative Function.

Allocation of functions in any of the three categories may change as the architecture evolves based on changing requirements or state-of-the-art.

PART 1

ALLOCATION OF TELECOMMUNICATIONS FUNCTIONS (BASELINE)

NODAL FUNCTIONS

FUNCTION	DESCRIPTION
Multipoint Circuit	Terminals share a single circuit.
Automatic Dialing	Acknowledge completion of connection. Function includes: recognition of ringing signal, answering incoming calls, generating positive response.
Data Network Interface	Provide medium for traffic exchanges with a terminal or node which is an integral part of a separate data network.
Commercial Interface/ Refile	Functions required to introduce a message from the IASA into a common carrier record network.
Alternate Routing	A process whereby substitute routes are used for transmitting messages when the terminal fails or when circuit failures occur on primary transmission paths or backlogs develop.
Intercept	Interim storage for traffic whose delivery has been halted by operator or system command. When intercept condition is revoked delivery is initiated. Provides capability to temporarily hold traffic for a tributary that is out of service; and to store traffic for a part-time terminal.
Content Addressing	Designation of addressee(s) by evaluation of message contents.
PLA/RI Conversion	Conversion from a plain language address to a coded routing indicator.
Local Distribution Determination	Determine action and info addressees within receiving organization; e.g., by analysis of certain fixed field parameters found in message. Combinations of parameters may be used

FUNCTION	DESCRIPTION
	to ascertain specific destinations for message. The order in which parameters determine destinations, the relative weighting (if any) given to each, and the combinations actually used vary depending on user distribution requirements. Appropriate handling procedures based on unique routing indicators, official titles, office symbols, local distribution parameters, and operator-initiated alternate routing based upon predetermined or operator-provided destinations.
DPI Interface	The function whereby an information processor is interfaced to the network processor. Also referred to as data processing installation (DPI) interface.
Pre/Post Processing	On-line sorting of incoming messages by parameters such as: precedence, classification, content indicator code, language media format code. Media conversion for manual interface compatibility or on-line interface.
Terminal Identification	Techniques to identify each terminal to the network.
User Identification	Techniques for verification of user authority to access the network.
Traffic Segregation	Function providing separation of traffic of two or more functionally different communities of interest; e.g., DSSCS and GENSER traffic.
Statistical Recording	Collection and evaluation of data concerning the flow of information in the network.
ACP 127/JANAP 128	Conversion of ACP 127 format to JANAP 128 format and vice versa.
DD Form 173 to JANAP 128/DOI-103	Conversion of DD Form 173 message form to JANAP 128 format or to DOI-103 format (DSSCS traffic)

FUNCTION	DESCRIPTION
Message Composition Assistance	Inserting, deleting, replacing characters in message text. Could be applied during message composition or error correction.
Retrieval	Message retrieval accomplished on-line, in real-time.
Referencing	Capability to retrieve messages referenced in an incoming message and provide the cutomer with the incoming message and/or assign the same distribution as assigned to the referenced message.
Code Conversion	System accept input from Communications & Data Systems and provides output to that system in ASCII or in its native language, on a case-by-case basis.
Query/Response	Exchange of a question and answer with no attempt to sustain the continuity of the information transfer process. Provides capability to access a distant data base with a question and receive an answer back via the AUTODIN system. Terminal uses an abbreviated header from which ASC builds a JANAP 128 DOI-103 (DSSCS) formatted header and routes message to proper host computer.
Interactive Exchange	The rapid exchange of information between subscribers in a conversational mode versus interactive mode transfer process is maintained.
Teleconferencing	More than two subscribers connected together in a conversational mode.
Electronically Supported Coordination	Provides ability to electronically hand off messages to other terminals for coordination of release.
Bulk Data Transfer	The transmission of files, programs, processing results, or data bases from one computer to another with transaction lengths ranging from 10 Kbits to 100 Mbits.

FUNCTION	DESCRIPTION
Error Checks & Correction	Includes all system provisions for detecting and/or correcting circuit/ transmission errors, maintaining message accountability, detecting security violations, maintaining message integrity, detecting format/ header errors on both front and back side.
In Transit Storage	Includes the storage of message traffic during the period beginning with "start of message out" from the ASC and ending with "end of message out" at the AMPE.
Overflow Protection	Includes system features and procedures which enable the system to continue receipt of traffic, either from the ASC or from connected remotes of peripherals, the saturated condition of IAS notwithstanding
Automatic Service Msg Generation	Includes all sytem features involved in the handling, origination and receipt of service msgs to/from front side of back side of AMPE.
Ship-to-Shore Communications	Includes system capabilities which permit the transmission and reception of AUTODIN messages between a land homed telecommunications center and seaborne customers.
On Line Locator	System capability which permits the maintenance of a unit locator system in a mobile situation, on-line updating of a subset of ACP 117.
Automation Assisted Traffic Mgmt.	Includes all system features which enable or assist traffic management.
Automated Supervision of Message Preparation	Includes system features which provides the message writer with assistance in entering a message into the system.

FUNCTION	DESCRIPTION
Message Mask Call-up from Remotes (AMPE Unique Function)	System features, either in the remote or in AMPE which provide masks on the screen of a VDU or KVDT to assist the remote user in msg entry.
Automated ACP 117 Maintenance (AMPE Unique Function)	Includes all system resources devoted to maintenance (automated, automation assisted or manual) of ACP 117, and any resources devoted to the use of ACP 117 in PLA/RI conversion.

TERMINAL FUNCTIONS

FUNCTION	DESCRIPTION
Card Medium	Data stored on punched cards is accepted for transmission; received data is converted to punched card and if required hard copy output for delivery to customers.
Paper Tape Medium	Data stored on paper tape is accepted for transmission; received data is converted to paper tape and if required hard copy output for delivery to customers.
Magnetic Tape (MT) Medium	Data stored on magnetic tape is accepted for transmission; received data is converted to magnetic tape for deliver to customers. Data is blocked with a fixed or variable number of characters per block changeable on a site by site basis.
Variable Length MT Records	Data stored on magnetic tape is accepted for transmission; received data is converted to magnetic tape for delivery to customers. Data is blocked with the number of characters varying from block to block, within specified maximum and minimum limits.
Hard Copy (Paper)	Received data is converted to printed paper copy for delivery to customers. Data recorded on paper is accepted for transmission.
Computer Output to Microfilm (COM)	Received data is converted to microfilm, microfiche, etc., for delivery to customers.
OCR Input	Data recorded on standard message forms is converted to a binary stream for direct input to an automated message processing system, or converted to another storage medium, such as paper or magnetic tape, for subsequent input to a message processing system.
Logging	Maintaining a continuous printout of events associated with terminal processing. Used by terminal operators.

FUNCTION	DESCRIPTION
Digital Facsimile	Transmission of images as a digital bit stream. The image is scanned at the transmitter, converted from an analog to a digital state, reconstructed at the receiving station, and duplicated on hard copy.
Video Transmission	Transmission of non-sinusoidal waveforms involving Megahertz frequencies; i.e., the transmission of a digitized wideband signal.
Digital Voice	Transmission of an analog voice signal which has been converted to a digital form for transmission.
Telemetry	Transmission of binary data derived from remote sensing of operating equipment.

PERVASIVE FUNCTIONS

FUNCTION	DESCRIPTION
Mode I Operation	Duplex synchronous operation with automatic error and channel controls which allow independent and simultaneous two-way traffic flow. Accomplished by means of control characters, which are used to acknowledge receipt of valid line blocks and messages or to return error information. Terminal or ASC respond automatically to these characters by continuing or stopping transmission or displaying action information to the operator.
Mode II Operation	Duplex asynchronous operation without the automatic error and channel controls which allow independent and simultaneous two-way traffic flow. Message accountability maintained through channel sequence numbers and service message actions.
Mode V Operation	Duplex asynchronous or synchronous operation, also called the teleprinter controlled mode, which offers character framing, detection, channel controls, and independent and simultaneous two-way traffic flow; control characters used to acknowledge receipt of messages and to display limited information to the operator. Message accountability is maintained through the use of channel sequence numbers with automatic response using control characters by the distant terminal/ASC. Error control is not provided.
Mode IB Operation	IBM Bisync or ANSI X3.28-1971 communications control procedures.
Mode IIA Operation	Asynchronous mode AUTODIN II communication control procedures. (10 or 11 bit ASCII).
Mode VI Operation	Synchronous mode AUTODIN II communications control procedures. (ADCCP, independent numbering).

FUNCTION	DESCRIPTION
Full Duplex	Transmission may occur on a circuit in both directions, simultaneously.
Half-Duplex	Transmission may occur on a circuit in both directions, but not simultaneously.
Simplex	Transmission may occur on a circuit in one direction only.
Multiple-Destination Addressing	A technique wherein information may be entered once at the terminal and is directed to several destinations. For example, several routing indicators in a message header.
Broadcasting	A method of transmitting messages/ information to a number of receiving stations.
Collective Addressing	A technique wherein a number of destinations may be addressed by a single code, for example, addressee indicator group (AIG).
Dual Homing	A technique whereby a telecommunications center is provided access to two network nodes either by having two terminals, each of which is homed to a different node or a single terminal homed to two nodes.
Multiple Precedence Levels	A technique wherein more than one precedence classification is assigned to information flowing in the network. Information is routed and delivered in a first in, first out by precedence manner.
Priority Interrupt	This function will suspend processing of a lower precedence message when a message carrying a specified higher precedence enters system, and returns to interrupted message when processing is completed, at the point of interruption or beginning of message, through multiple levels of precedence.
Mail Box Service	Traffic is held for delivery on an on-call basis.

FUNCTION	DESCRIPTION
Retransmission	The repetition of a message previously transmitted.
Privacy of Traffic	AUTODIN I implementation is AUTODIN limited privacy service (ALPS) which will allow special compartmented traffic to pass through the AUTODIN system without being recorded on history or log tapes. Provides limited amount of privacy since no recorded copy will exist. AUTODIN II will inherently support this function since there is not secondary storage in the switching network.
Journaling	The storage of a copy of transmitted and received information and a record of the processing events associated with each message. Examples of entries would be start of input, end of input, start of output, end of output. The journal is balanced for traffic analysis and for recovery after system failure. Provides audit trail.
Audit Trail	Function provided by journaling whereby messages logged, e.g., on magnetic tape as received, carried as open entries until successfully delivered. When message acknowledged by end device, or in case of uncontrolled circuits, when message output completed, event is recorded on tape as closing entry. During processing, while message is in system, internal lists and tables of message status constantly updated.
History	Maintenance of a complete copy of transmitted and received traffic.
Decayed Data Removal	Ability to remove or update messages which are outdated or no longer needed for backup. This includes data stored anywhere in the system.

FUNCTION	DESCRIPTION
Code Independent Transmission	Bit oriented, data code independent transmission.
Logical Addressing	Addressing capability in which a subscriber is assigned a single logical address, regardless of physical address. The network accomplishes the translation from logical to physical addressees for delivery.
Network Virtual Terminal	Intercommunications between normally incompatible terminals by mapping each into and out of a network standard imaginary device termed a "network virtual terminal."
On-Line Delivery	On-line, real-time subscriber-to-subscriber delivery, with immediate delivery acknowledgement from destination node to the originating subscriber.

PART 2

CATEGORY I: MINIMUM ESSENTIAL FUNCTIONS

NODAL FUNCTIONS

Terminal Identification

User Identification

Traffic Segregation

Statistical Recording

ACP 127/JANAP 128

Commercial Interface/Refile

Code Conversion

Alternative Routing

Intercept

Retrieval

On Line Locator
(AMPE Unique Function)

Audit Trail

Bulk Data Transfer

Query/Response

Interactive Exchange

Error Checks & Correction

In Transit Storage

Overflow Protection

Automatic Service Msg Generation

Ship-to-Shore Communications
(AMPE Unique Function-Navy)

TERMINAL FUNCTIONS

Card Medium

Paper Tape Medium

Magnetic Tape (MT) Medium

Variable Length MT Records

Hard Copy (Paper)

Logging

Automation Assisted Traffic Management
(AMPE Unique Function)

Automated Supervision of Message Preparation
(AMPE Unique Function)

Message Mask Call-up from Remotes
(AMPE Unique Function)

Automated ACP 117 Maintenance
(AMPE Unique Function)

PERVASIVE FUNCTIONS

Mode I Operation
MODE II Operations
Mode V Operation
Mode IB Operation
Mode VI Operation
Full Duplex
Half-Duplex
Simplex
Multiple-Destination Addressing
Collective Addressing
Dual Homing
Multiple Level Precedence
Priority Interrupt
Retransmission
Journaling
Audit Trail
History
Mode IIA

CATEGORY II: OPERATIVE FUNCTIONS

NODAL FUNCTIONS

Multipoint Circuit
PLA/RI Conversion
Lcal Distrubution Determination
DPI Interface
Pre/Post Processing
DD Form 173 to JANAP 128

TERMINAL FUNCTIONS

OCR Input
Digital Facsimile
Privacy of Traffic
Code Independent Transmission
Logical Addressing

CATEGORY III: STATE-OF-THE-ART FUNCTIONS

NODAL FUNCTIONS

Message Composition Assistance
Automatic Dialing

Content Addressing

Referencing

Teleconferencing

Electronically Supported Coordinated

TERMINAL FUNCTIONS

Computer Output to Microfilm (COM)

Video Transmission

Digital Voice

Telemetry

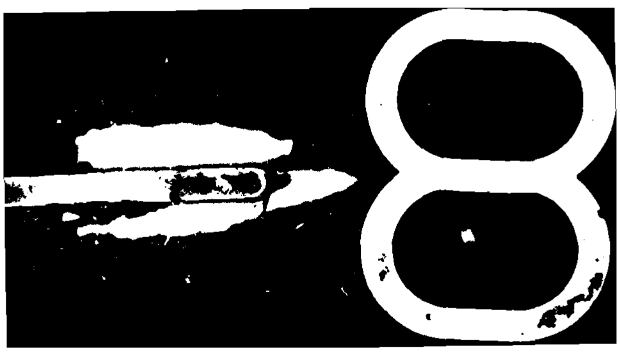
Broadcasting

Mail Box Service

Decayed Data Removal

Network Virtual Terminal

On-Line Delivery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